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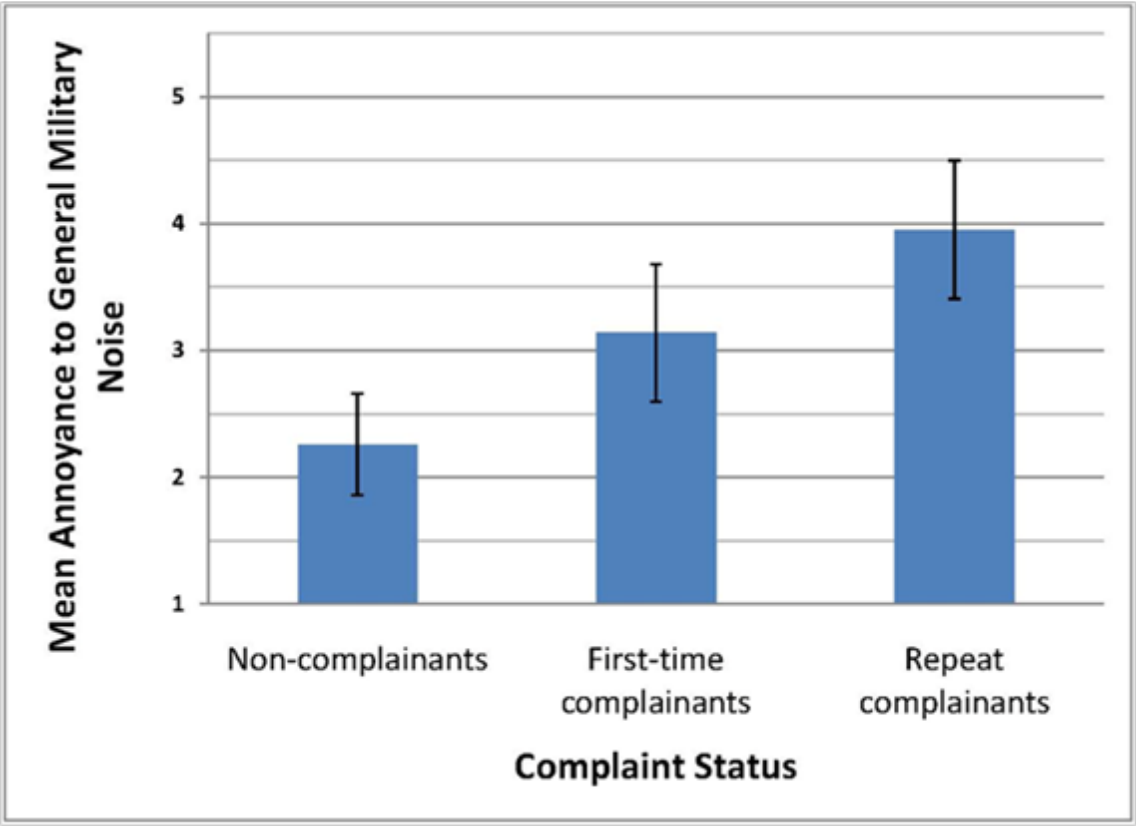
Strategic Environmental Research and Development Program (SERDP)

An Investigation of Community Attitudes Toward Blast Noise

Complaint Survey Protocol

Edward T. Nykaza, Kathleen Hodgdon, Gloria Wienke,
Trent Gaugler, Peg Krecker, and George Luz

April 2012



Complaint and matched-sample grid cell example

Construction Engineering Research Laboratory

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Abstract

Current blast noise impact assessment procedures do not fully meet the military's noise management needs. In particular, it is unclear how an installation or range commander should interpret blast noise complaints. This work investigated whether there are significant differences in reported annoyance to complaint-referenced blast events between complainants and their non-complaining neighbors. It was found that complainants were significantly more annoyed to both complaint-referenced blast events and general military noise in comparison to their non-complaining neighbors. These findings are discussed in the context of range management.

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Preface

This study was conducted for the Strategic Environmental Research and Development Program (SERDP), under Project SI-1546, "An Investigation of Community Attitudes toward Blast Noise Complaint Survey Protocol" via Military Interdepartmental Purchase Request (MIPR) W74RDV20307627. The SERDP technical monitor was Bruce Sartwell, SERDP.

The work was performed by the Ecological Processes Branch (CN-N) of the Installations Division (CN), Construction Engineering Research Laboratory (ERDC-CERL). The CERL principal investigator was Edward T. Nykaza. Special acknowledgement is given to Dr. Larry Pater for his input, guidance, and support during the planning phase of this project. The team would also like to thank Bob Cvengros for his work on processing the data, and Bruce MacAllister and Jeff Mifflin for their hard work in the field during the data collection phase of this research. William Meyer is Chief, CEERD-CN-N. Dr. John Bandy is Chief, CEERD-CN. Alan Anderson is Technical Director, CEERD-CV-T. The Director of ERDC-CERL is Dr. Ilker R. Adiguzel.

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1 Introduction

1.1 Background

1.1.1 Blast noise

In the United States, the number of people living near military installations is steadily growing. The US General Accountability Office (GAO) reports that "urban growth near 80% of its (DoD) installations exceeds the national average" (GAO 2002). This suburban sprawl, combined with the escalation of military activities over the past decade, has heightened the potential for noise generated by US military installations to negatively impact surrounding communities.

For many years, one of these sources of noise, military blast noise generated from military testing and training activities (i.e., the noise emitted by large weapons, heavy artillery, and explosions) has caused community disturbances and resulted in complaints and other vigorous action (e.g., citizen petitions to the US Department of Defense [DoD], Internet-based political action groups, tort claims, and lawsuits). While there has never been a successful law suit against the Army over blast noise, there have been many tort claims. Moreover, complaints and more vigorous community action often result in curfews or other types of restriction. Curfews and restrictions result in a need for soldiers to travel farther to reach locations where they can train to standard, a circumstance that is particularly troublesome for National Guard forces, which must frequently travel to their weekend training site on highways.

Changes in training due to blast noise complaints have ranged from complete closure of all heavy weapons ranges (Fort Belvoir, VA; Fort Ord, CA; Camp Edwards, MA; Fort Devens, MA) through closure of some ranges or firing points (Fort Sill, OK; Fort Lewis, WA; Camp Blanding, FL; Camp Bullis, TX; Fort McClellan, AL; Fort A.P. Hill, VA) to curfews (Fort Benning, GA; Fort Knox, KY) or limits on the size of explosions (McAlester Army Ammunition Plant, OK, Aberdeen Proving Ground, MD). From these impacts, it can be inferred that blast noise costs the Army millions of dollars per year. As more people move closer to military installations (a current trend), encroachment issues such as noise have the potential to cause further repercussions.

1.1.2 Current blast noise assessment procedures

Blast noise is characterized as low-frequency, high-energy, short duration impulsive sound. Typical blast noise event durations range from a few milliseconds to a few seconds and have acoustical spectrums that range from 1-2000 Hertz (Hz). Most of the acoustical energy of blast noise is concentrated between 10-100 Hz; as a result, it travels with little attenuation through the atmosphere and can be loud at distances on the order of 10s of kilometers from the source. However, the propagation of blast noise through atmosphere is highly variable and strongly influenced by atmospheric temperature and wind structure. Propagation experiments done with all factors held constant except for weather have shown that received noise levels can vary by as much as 50 decibel [dB] (Schomer, Goff, and Little 1976).

Two approaches to high-intensity impulsive sound have been incorporated into the most recent version of Army Regulation (AR) 200-1, *Environmental Protection and Enhancement* (HQDA 2007). The standard method uses a computer model (i.e., BNOISE2 [Pater 2008]) to generate maps of the annual average exposure in decibels of C-weighted day-night average sound level (CDNL), which is in turn interpreted in terms of the percentage of the population that would be expected to describe themselves as "highly annoyed" at a specific decibel value. The second approach uses either direct measurement of impulsive noise from blast noise monitors or mathematical models for predicting the intensity of single events. These levels are in turn interpreted in terms of complaint risk using a table originally developed by Pater (1976) for complaint management at the Naval Surface Weapons Laboratory, Dahlgren, VA (NSWC/DL). Neither approach has proven itself to be completely satisfactory. Also, some experts question the value of the recent addition of the noise complaint guidelines. Tables 1 and 2 list the limits used in interpreting noise levels for these two methods of assessment.

Table 1. Land use zones from AR 200-1.

Noise Zone	%HA	CDNL	Compatible for residential use (schools, housing, and medical)
Zone I	< 15%	<65	Yes
Zone II	15-39%	65-75	Not normally recommended
Zone III	>39%	>75	Not recommended

Table 2. Pater complaint risk criteria.

Risk of noise complaints	Single Event ZPk (dB)
Low	< 115
Moderate	115-130
High	> 130
Risk of physiological damage to unprotected human ears and structural damage claims	> 140

Neither method adequately captures the way humans respond to blast noise nor properly accounts for the number, timing, and level of blast noise events (HQDA 2007; Pater et al. 2007; Nykaza, Luz, and Pater 2008). When first introduced, the CDNL methodology for high-energy impulse noise* accounted for the only available data, which came from a 1964 study by the Federal Aviation Administration (FAA) in which residents of Oklahoma City were interviewed after being subjected to various levels of sonic booms. Later, when blast noise data points from US Army interviews of people living near Fort Lewis and Fort Bragg were added, the scatter of data points increased, but was still statistically significant. However, when data points from Sweden and a National Aeronautics and Space Administration (NASA) study of sonic booms were added, the scatter bordered on being meaningless (Figure 1, right). The limited predictive validity of CDNL has been acknowledged in the most recent version of Army policy (HQDA 2007).

The 2007 version of AR 200-1 states that: "The use of average noise levels (i.e., day-night level [DNL]) over a protracted time period generally does not adequately assess the probability of community noise complaints." For example, if a community is exposed to 100 blast noise events over the course of a year and each received level has a Z-weighted peak pressure level (ZPk) of 142 dB, the corresponding CDNL would be 62 dB. A CDNL of 62 dB suggests that it is acceptable for all residential land uses (see Table 1). However, a ZPk of 142 dB is so loud that it would almost certainly cause a strong negative public reaction (e.g., complaint or lawsuit), and in fact exceeds the 140 dB threshold for human hearing damage (DOL 1983, DoD 1997).

* Historically, blast noise and sonic booms have been grouped together under the category of high-energy impulse noise since both signatures have the majority of their acoustical energy at low frequencies (e.g., 10-100 Hz). Whether a single assessment criteria can be used for both sources, is an unsolved research question.

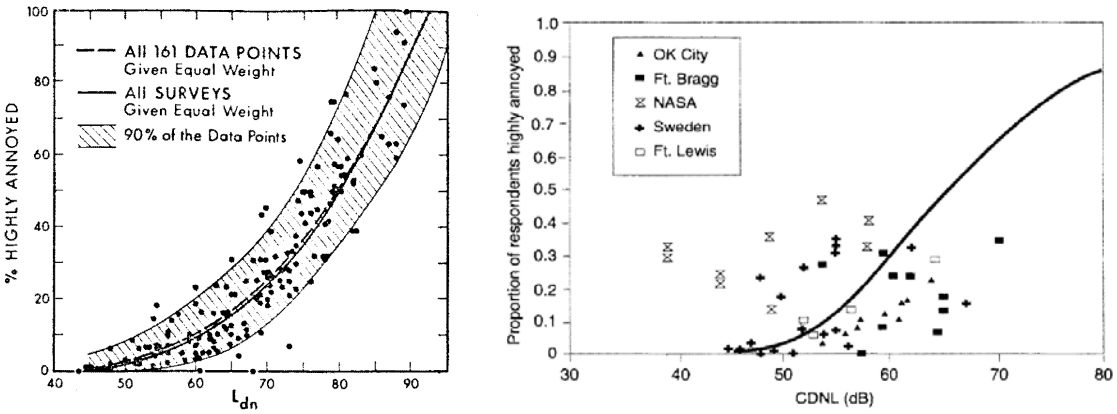


Figure 1. Schultz 1978 %HA vs. ADNL (left) and CHABA 1996 %HA vs. CDNL (right).

1.1.3 Complaints and annoyance

1.1.3.1 Historical perspective

When the US Army first began to address high-intensity impulsive sound in the late 1950s, the concern was damage to buildings (Perkins and Jackson 1964). Because the probability of building damage is tied to the most intense event, the Army's focus was on the peak decibel level without regard for the number of events per day. Concern with annoyance was introduced by the FAA. In 1964, the FAA funded a 6-month acceptability test for sonic booms using social surveys conducted by Columbia University. The respondents lived in Oklahoma City, OK, and the acoustic measure was peak level. When the US Environmental Protection Agency (USEPA) published a set of guidelines for the management of urban and transportation noise (USEPA 1974), the authors added an appendix (Appendix G) to address impulse noise. The authors of Appendix G reworked the Oklahoma City data into an algorithm for determining the acceptability of day-time sonic booms.

Unlike the earlier Army approach, which emphasized the most intense event, the USEPA algorithm allowed for a daily tradeoff in terms of the peak decibel level and the number of sonic booms. In 1975, the Army Medical Department attempted to use the Appendix G sonic boom guidelines to assess a tank gunnery range at Fort Drum, NY, but the guidelines were not amenable for dealing with hundreds of events at a wide range of decibels, some of which were at night. Subsequently, the Army Corps of Engineers funded a study of weapons noise annoyance at Fort Bragg, NC. When the social survey results from the Fort Bragg weapons noise study and the Oklahoma City sonic boom study were expressed in terms of CDNL and the percentage of persons reporting themselves as "highly annoyed," the two sets of data were in reasonable agreement, and the Na-

tional Academy of Sciences/National Research Council Committee on Hearing, Bioacoustics, and Biomechanics (CHABA) experts fit an annoyance curve to the data set. Based on this limited data set, the Army decided to adopt the annoyance-based approach for environmental assessments and land use planning.

At that time, the DoD was already engaged in land use planning around military airfields using noise contour maps of the A-weighted DNL (ADNL) recommended by the USEPA in its 1974 guidelines. That effort was known as the Air Installation Compatible Use Zone (AICUZ) program. The AICUZ noise criteria had been set at a level considered to be fair both to existing residents who were already exposed to aircraft noise and to the owners of land in the vicinity of airfields who might want to develop their land in the future. The AICUZ noise criteria defined land exposed to a DNL of less than 65 decibels as compatible with residential use and land exposed to a DNL of between 65 and 75 decibels as normally incompatible with residential use. To be fair and equitable in land use planning around heavy weapons ranges, the Army accepted the principle of equivalent annoyance. Under this principle, the noise criteria for land in the vicinity of a range were to be set at the same level of annoyance as the AICUZ criteria. In making this equivalence, the Army relied on a study of the percent highly annoyed (%HA) from transportation noise published by Schultz (1978) and the annoyance curve that CHABA experts had recommended for the Fort Bragg/Oklahoma City data set. The 1978 Schultz curve is reproduced in Figure 1, left. Table 1 from AR 200-1 shows the equivalences recommended by CHABA.

With continued experience applying the CHABA criteria, a situation arose where one community judged to be compatible was vigorously complaining about their exposure and another community judged to be incompatible was protesting the Army's publication of the noise contours. Other, less dramatic disconnects were observed. In 1996, CHABA revisited the blast annoyance curve with the addition of data published after 1981. These data, which are reproduced from CHABA (1996), are shown in Figure 1, right. As is obvious from visual examination of Figure 1, the correlation between the CDNL and high annoyance was minimal. One of the recommendations of CHABA (1996) was to change the threshold of incompatibility from 62 to some lower decibel value. Another was to consider a different method of counting blast events. Since CHABA failed to provide evidence that the new method would improve the correlation between CDNL and high annoyance, the authors of AR 200-1 took no action.

Particularly destructive to the correlation between CDNL and high annoyance was the addition of sonic boom data from a study conducted by NASA in the vicinity of Nellis Air Force Base (AFB), NV. Although other research has shown that sonic booms and small explosive charges are not equally annoying when measured with C-weighting (Schomer and Sias 1998), this relatively small difference does not account for the degraded correlation, since respondents in the Nellis AFB study were among the most annoyed and respondents in the Oklahoma City study were among the least annoyed.

1.1.3.2 The relation between complaints, annoyance, and noise

The assumption that people who complain about noise represent a larger percentage of the population that is equally annoyed is questionable (Nykaza et al. 2005). In general, there still remains some controversy on the relationship between complaints and annoyance (Maziul, Job, and Vogt 2005) and it is debatable whether complaints and/or annoyance should be used as the response metric in Federal and local policy (Fidell 2003). Some early studies of community response to intrusive noise assumed that there was a relationship between the complaints of a few and the average annoyance of the entire noise-exposed population.

In a 1972 study of community reaction to aircraft noise around smaller city airports, it was hypothesized that the prevalence of noise complaints is proportional to the square root of the prevalence of annoyance (Tracor 1972). Guski hypothesized that telephone complaints received by local government could be used to rank order the degree of community annoyance from different intrusive sounds (Guski 1977), but when Avery tested this hypothesis, it failed (Avery 1982). Whereas complaints about factories were far more prevalent than complaints about traffic (26% for factories vs. 8% for traffic), more of the community was bothered (annoyed) by traffic than by factories (48% for traffic vs. 19% for factories). Similarly, less than 1% of complaints were about aircraft even though 38% of the community admitted being bothered by aircraft. Mabry and Carey analyzed complaints received by seven Air Force bases and concluded that a correction to DNL (a measure of annoyance) is required for sporadic or non-routine activities (Mabrey and Carey 1980). In 1983, Luz et al. carried out a similar analysis for blast and aircraft noise complaints received by US Army installations and concluded that complaints were triggered by unusually noisy events (Luz, Raspet, and Schomer 1983).

Complaints and annoyance both capture some aspect of the human experience to noise, but they do so in different ways. Complaints are spontane-

ous, unsolicited snapshots of high annoyance to recent noise events given by individuals; annoyance is solicited through expensive social surveys that capture the community opinion of historical noise events over some time period (e.g., 1 year). Whereas studies of annoyance document a community's overall response to the cumulative daily noise exposure, studies of complaints highlight features of the cumulative exposure that are particularly burdensome.

Complaints and annoyance are usually (but not always) related to noise exposure. For example, the degradation of the relationship between CDNL and the annoyance of high-intensity impulse noise discussed above is due to the decoupling of annoyance and noise exposure in NASA's study of sonic booms conducted outside Nellis AFB (cf. Table 1). Repeating the same study outside Edwards AFB yielded less annoyance, but no better dose-response (Fields 1997). On the other hand, Hume et al. (2003) showed an orderly relationship at the Manchester (England) Airport between noise level of individual flights, and the mean number of noise complaints over the period 1998 to 2000 (Hume, Morley, and Thomas 2003). The time of day is also important to complaint and annoyance response. The DNL penalizes sounds that occur during the night; there is a higher incident of likelihood of receiving a complaint from activities that occur between 2300 and 0700 and on the weekends (Hume et al. 2003, Ashman 2007).

Both high annoyance (Schomer 1985) and complaints (GAO 2000) can occur in areas that are exposed to low levels of noise, which may be explained by noise sensitivity. Furthermore, the expectation of the increase in noise has been shown to increase annoyance (Hatfield et al. 1998; Wirth, Brink, and Schierz 2003) and increase complaints (Hume et al. 2003). If an individual is already stressed by other non-noise factors, the source noise many be more annoying than usual (Maziul, Job, and Vogt 2005). Conversely, low annoyance (Vogt and Kastner 1999) and low prevalence of complaints (Wiechen et al. 2002) can occur in areas of high levels of noise. In some cases, the decrease in annoyance or complaints may be explained by habituation (Brink and Wunderli 2010) and in other cases, the decrease may be related to sound insulation (Wiechen et al. 2002).

1.1.3.3 Complainants

A complaint is an outcome of an individual's decision that can be modeled as a discrete choice problem; either the individual complains or does not (Gillen and Levesque 1994). Complaining can be regarded as a coping behavior (Wiechen et al. 2002). Put another way, residents complain because

of inadequate coping strategies (Hume, Terranova, and Thomas 2001). Unsuccessful coping might increase annoyance (Botteldooren, Verkeyn, and Lercher 2003), may explain the abundance of repeat complainants (Flindell and Witter 1999; Hume, Terranova, and Thomas 2002), and may underlie the importance of responding to complainants correctly the first time they complain (Luz, Raspet, and Schomer 1983).

People who are likely to complain typically do not fit the average population description (Tracor 1970). Complainants are usually older and better educated, have higher economic and social status (Morley and Hume 2003), are members of environmental organizations (Guski 1977, Borsky 1979, Wiechen et al. 2002), and are more likely to sign petitions and attend public meetings and demonstrations (Maziul, Job, and Vogt 2005).

Key factors that influence complaint behavior are knowledge of where to go to file a complaint, the expectation it will do some good, confidence in one's ability to deal with authorities, and past complaint experience (Borsky 1979). Some of the reasons why residents do not complain are because the resident believes that the complaint will have no consequences, that nothing can be done about the noise, or that authorities will not do anything about the noise (Maziul, Job, and Vogt 2005). Whether the resident owns or rents his home and how busy the individual is may affect the propensity to complain (Hume et al. 2003). In terms of non-acoustical factors, complainants are typically more noise sensitive, concerned about health, fearful of a crash (for aircraft), highly annoyed, and likely to experience sleep disturbance (Wiechen et al. 2002).

1.1.3.4 Measuring noise impact in terms of annoyance

Community response to high-intensity impulsive sound, such as from bombs, demolitions, sonic booms, and heavy weapons, is an issue unique to the DoD. This issue was first addressed by CHABA in 1977 (von Gierke 1977). CHABA, operating with funding from DoD, provided DoD with a methodology for assessing the impact of various combinations of exposure to high-intensity impulsive noise on communities. CHABA's unique approach was to measure this noise with C-weighting of the sound level meter and assess it with a measure previously-introduced by the USEPA (1974) for assessing transportation noise. This measure, known as the CDNL, emphasized the cumulative exposure from all the impulsive noise received in noise-sensitive areas (homes, churches, schools). Measurement of sound

events with C-weighting rather than A-weighting* emphasized the low-frequency sound energy that results in the vibration and rattle of buildings. See Appendix A for an overview of common metric level weightings.

CHABA's endorsement of the cumulative exposure and DoD's acceptance of this cumulative daily exposure approach discouraged persons responsible for environmental assessment of military noise from looking at the statistical distributions of the individual acoustic events as well as complaint-referenced blast events (CRBE). Although CRBEs were used by range managers (Pater 1976), they were not used in noise assessments.

Because of the DoD's acceptance of the CHABA recommendations, the Army assesses the noise impact of a proposed or modified range in terms of annoyance. However, range operators receive post-construction feedback (if any) in terms of noise complaints. Installation commanders take noise complaints seriously, and they often impose testing and training restrictions based on complaints. This is particularly true for Congressional inquiries. It is not established, however, whether it is appropriate to impose testing and training restrictions based on complaints, or whether responding to complaints is an effective means of reducing blast noise impacts on the general public.

In 2004, the Strategic Environmental Research and Development Program (SERDP) took action to bring the focus back to the underlying distribution of individual acoustic events by funding the University of Pittsburgh to develop an artificial neural network classifier to identify military impulsive noise (Bucci and Vipperman 2007). There is a need t0o extend this earlier SERDP work by looking at ways to interpret the output from devices such as that designed at the University of Pittsburgh. To that end, this work focuses on the relationship between noise complaints and subjective annoyance —a measure that has been used extensively in social surveys of noise-exposed communities— to address two major questions:

- Can individual complainants be used as a surrogate measure of the average annoyance of the larger community?
- Do those who self-report annoyance to blast noise via complaints to military installations represent the opinion of their neighbors, or are individual complainants outliers on the statistical distribution of individual subjective annoyance?

* Note that A-weighting is used for the assessment of all noise sources unless otherwise indicated.

1.2 Objective

The overall objectives of the SERDP SI-1546 Project, "Assessing community attitudes toward military blast noise" (Hodgdon 2009) were to:

- enhance the understanding of community attitudes toward military blast noise.
- develop a methodology to accurately predict human response to military blast noise.
- recommend guidelines to minimize blast noise impacts on sustainable training and public welfare.

The current study addresses the first of these overall objectives by exploring the relationship between complaints and annoyance.

1.3 Approach

1. A complaint survey (CS) was designed and administered at a participating military installation.
2. The data were collected by administering the CS instrument.
3. The collected data were analyzed using two analysis of variance (ANOVA) models, and the results were summarized.

1.4 Mode of technology transfer

It is anticipated that the results of this work will complement the results of earlier studies that explored the relationship between military blast noise and sleep disturbance at different times of night (Nykaza et al. 2009) and the likelihood of complaints for blasts of different intensities (Nykaza et al. 2008b). These results will complement the WP-1546 personal interview study (Hodgdon et al. 2009), the general community surveys (Nykaza et al. 2012), and other in-situ studies. This report will be made accessible through the World Wide Web (WWW) at URLs:

http://www.cecer.army.mil
http://libweb.erdc.usace.army.mil

2 Materials and Methods

2.1 Data collection

The CS was designed to capture the near real-time annoyance response of complainants and their neighbors to meet the study's objective of determining whether individual complainants can be used to predict community annoyance. Each time a complaint was made to the participating installation,* the goal was to capture telephone survey responses from the complainant and nine residents living in close proximity to the complainant, also referred to as the "matched sample." For this study, it is assumed that residents living in close proximity to the complainant were exposed to the same noise environment; thus, the study was designed without the capture of stimulus or noise data. The data collection goals, which were based on historical complaint data and feasibility constraints, were to complete a total of 500 telephone surveys with 50 complainants and 450 of their neighbors.

2.2 Survey instrument

Appendix B contains the data were collected by administering the CS instrument. The CS was developed in conjunction with other SERDP survey instruments (i.e., in-situ and general community surveys). The CS instrument and procedure was reviewed by the Office of Management and Budget (OMB No: 0710-0015) and approved by the Pennsylvania State Office of Research Protections Institutional Review Board (IRB No. 27457). Appendix C contains the CS recruitment and consent form.

The design of the CS, with two exceptions, used the recommended set of noise-reaction questions from the International Commission on the Biological Effects of Noise (ICBEN) (Fields et al. 2001). The first exception is that ICBEN suggests the use of both the 5-point verbal and 11-point numerical noise-reaction questions for the purpose of making comparisons to other social surveys. This study used only the 5-point verbal question to reduce the respondents' burden. The second exception is that ICBEN discourages the use of screener questions such as "have you ever heard the noise of interest." This study asked residents if they heard blast noise

* The name and location of the participating installation have intentionally been removed from this report.

events on a specific date and time to establish whether the respondent heard and was home during the time of the CRBE.

The survey asked a total of 43 questions, including two annoyance questions. The categories of questions on the survey ranged from general questions about the neighborhood and environment, to specific questions about CRBE, importance of the installation, and characteristics of the respondent household. Respondents were asked to rate their annoyance to the CRBE and to general military noise. The annoyance questions were fully-labeled Likert scale items (Anderson, Basilevsky, and Hum 1983). That is, the response specified five ordered categories and each category had a text description that was read, in full, to the respondent. The categories, or points on the scale, were "Not at all annoying," "Slightly annoying," "Moderately annoying," "Very annoying," and "Extremely annoying."*

2.3 Sampling procedures

Implementing the survey required creating clear definitions of several core concepts and developing rules for how to deal with unusual situations without compromising the integrity of the study design and the statistical analysis, for example, to determine:

- how to define "close proximity" or "immediate vicinity" of the complainant so that it honors the concept of "same noise environment," but is also feasible for sampling households
- how to identify complainants in a timely manner
- what should be done if a small number of households repeatedly file noise complaints.

The main elements of the survey protocol are described below. Appendix D includes detailed sample rules and definitions.

The sample for the CS was driven entirely by complaint behavior at the participating installation. That is, a sample point was generated when the installation Public Affairs Office received a noise complaint. The installation Public Affairs Office documented the complaint, including the name, address and contact information of the complainant, the date and time of the event, and any relevant notes. This information was promptly shared

* A fully-labeled scale contrasts with a numeric scale that labels only the endpoints and leaves the interpretation of the intervening points to the respondent. For example, "Using a scale from 0 to 10 where 0 means "not at all annoyed" and 10 means "extremely annoyed," how would you rate your annoyance to <noise source>?"

with the research team, including the researchers overseeing the implementation of the survey. The survey research team assessed the eligibility of the complainant and identified the eligible sample for the surveys of matched households.

Procedural rules for defining eligible *complainants* involved repeat complaint behavior and the occurrence of multiple complaints within the same immediate vicinity. For example, one procedural rule was that "repeat complainants" would be eligible for up to two complaints. If multiple complaints were received about the same event and from the same immediate vicinity, then one of the complaints would be randomly selected and that complainant would be used to draw the matched sample. If multiple complaints were received about the same event, but from different areas, each complainant was used to draw an accompanying matched sample.

The main eligibility criteria for the sample of *matched households* involved geographic location and prior complaint behavior. Matched households must (reasonably) be exposed to the same noise environment and were therefore defined as households within 1 km^2 of the complainant's household (described below). In addition, a household that had previously been interviewed as a complainant earlier in the study was not eligible to be interviewed as a matched household for a subsequent noise event. (See Appendix D for detailed sampling rules.)

To ensure that matched-sample of households were sampled from the same noise environment as that of the complainant, the entire region was mapped with overlaying grids that reflected 1 km^2 areas with matched alpha-numeric indicators on the population database. These areas were designated "A-level grid cells," and the objective was to identify and interview nine households in the same or adjacent A-level cell as the complainant. For example, in Figure 2, if the complainant was located in A-level grid cell A1331, then the matched-sample was drawn from A1331 and the adjacent grid cells colored blue.

To maximize reliability of respondents' reported annoyance about the noise event, it was important to conduct the surveys as quickly as possible following the complaint. The timeframe for completing interviews of complainants and the matched households was defined as, at most, 2 weeks from the date of the complaint.

A1205	A1269	A1333	A1397	A1461
A1204	A1268	A1332	A1396	A1460
A1203	A1267	A1331	A1395	A1459
A1202	A1266	A1330	A1394	A1458
A1201	A1265	A1329	A1393	A1457

Figure 2. Complaint and matched-sample grid cell example.

The implementation of the survey protocol (lab staffing, sampling and locating records, callback schedules) focused on completing the data collection for any given noise event within 1 week; the 2-week timeframe was necessary in sparsely populated areas or where it required more calls to locate individuals within the same area who were home at the time of the event.

3 Results and Discussion

3.1 Overview of data collection

CS data were collected from September 2008 through 31 March 2009. The final dataset was comprised of 197 observations associated with 21 noise complaints. The final data fell short of the target number of 500 observations (50 complaints) because relatively few noise complaints were received by the installation during the field period. Although the study procedures and survey instrument were in place in September 2008, the first complaint was not received until 5 November 2008. Complaint activity was heavily clustered in six time periods: early and late November 2008 (11/5-11/6, 11/20-11/25), early and mid-December 2008 (12/3, 12/10, 12/16-12/18), late January 2009 (1/21, 1/23), and early February 2009 (2/7, 2/8).

The total number of matched-samples that were home and recalled the CRBE also did not meet expectations. Of the matched-sample, some chose not to participate, some were not at home at the time of the CRBE, and some were home, but did not recall hearing the CRBE. As will be discussed in the following section, of the 21 complaints received during the study only 17 could be used in the analysis due to incomplete data sets from matched households on the variables of interest.

3.2 Analyses

Two ANOVA models were run using SAS on the data since there were two annoyance-related questions. Appendix E includes a brief description of the ANOVA model. One question asked respondents to rate their annoyance to general military noise, and another asked respondents to rate their annoyance to the CRBE. The respondents were divided into non-complainant and complainant groups, which slightly differed depending on the annoyance response being analyzed. The majority of the respondents answered the question regarding annoyance to general military noise, but only 61 of the 197 respondents were home at the time of the CRBE and rated their annoyance to the CRBE.

3.3 Results

The CS asked a total of 43 questions including two annoyance questions in which the respondents were asked to rate their annoyance to the CRBE and to general military noise. The annoyance questions were anchored on

a Likert scale. A Likert scale is an attitudinal scale that assesses responses using a series of statements. The scale is typically defined from 1 to 5, with verbal anchors, or descriptors, that indicate the strength of the response in incremental levels. When asking about annoyance, the range was defined by the following five response descriptors: “Not at all annoying,” “Slightly annoying,” “Moderately annoying,” “Very annoying,” and “Extremely annoying” (Aiken 1997).

Appendixes F and G include tables that list the distribution of responses from all respondents and complainant group statistics, respectively. In general it was found that the residents surveyed in this study rate their neighborhood as a good or excellent place to live. Also, the majority of respondents report that their neighborhood is somewhere between quiet and average given the choice of responding quiet, average, or noisy. Of the residents who were home during the CRBEs, approximately 87% experienced rattle or vibration from the CRBE and of those respondents that mention rattle/vibration, approximately 78% report that their windows rattled.

3.3.1 Annoyance to CRBE

The primary analysis for this study was a test of differences in reported annoyance to CRBE (cf. Question 19 in Appendix B) between complainants and the matched-sample. For this analysis, complainants were simply defined as those who filed a complaint to the installation, and the matched-sampled were defined as the respondents living in close proximity to the complainant, who were home during the CRBE, and who did not complain. While these definitions seem trivial, they are given because respondents were grouped differently in the analysis of annoyance to general military noise (Section 3.3.2).

An exploratory correlation analysis was done to examine the relationship between the annoyance response variable and possible covariates. The covariates considered included a composite noise sensitivity rating, composite installation importance rating, and distance of the respondent from the source. Noise sensitivity is a term commonly used to describe individuals that are more aware, affected, or reactive to noise than most people. It is commonly used in human response to noise studies to assess individual’s self-rating of their annoyance to noise through a series of multi-part questions. Responses from Questions 6, 11, and 25 were combined to create a noise sensitivity variable that was used as an indication of potential annoyance. This variable was named *Noise Sensitivity*. The three series of questions asked respondents to rate annoyance to impulsive sounds heard

within a community, noises from different modes of transportation, and their perceptions regarding an individual's ability to adapt to noise. Responses from Questions 26 through 29 were combined to form a second possible covariate, this one measuring the importance of the installation in the community.

Appendix H includes a description of the covariates and a list of survey variables used in the ANOVA. The results of this analysis show that *Noise Sensitivity* ($p = 0.001$) and *Installation Importance* ($p = 0.009$) were significantly correlated with annoyance to CRBE. Table 3 lists output from the correlation analysis. Note that *Noise Sensitivity* and annoyance have a positive correlation (e.g., as individuals become more noise sensitive, they tend to be more annoyed), whereas installation importance and annoyance have a negative relationship (e.g., increased feelings of importance of the installation tend to be associated with decreased annoyance). Due to the limited sample size only the most significant covariate, *Noise Sensitivity*, was included in the analysis of covariance (ANCOVA) that followed. However, this model was discarded and replaced with an ANOVA because the relationship between the response variable and the continuous predictor was not entirely linear over the range of possible values of the predictor, which was a violation of a key assumption underlying the ANCOVA model.

The responses to Questions 1, 4, 30a, 32, 33, 34, 35, 36, 38, 39, and 42 (Table 4 or Appendix B) were included as independent categorical variables in the full model. A weekday (yes/no) variable that captured the day of the complaint (i.e., weekday or weekend), and complaint (yes/no) that indicated whether the respondent was a complainant or matched-sample, were also included in the model. The event identification variable was used as a random blocking factor to account for correlations between responses to the same CRBE. Model reductions were performed to discard non-significant variables ($p > 0.20$) and at each reduction step a check was done to ensure the normality and homoscedasticity assumptions were satisfied. Homoscedasticity is a condition of constant variance of the response variable amongst the groups defined by the different levels of all the factors in the model. In this case, the response variable is annoyance.

Table 5 lists the output for the final ANOVA model; these results are discussed in Section 3.3.1.

Table 3. Correlation analysis output for annoyance to CRBE.

Parameter	Correlation	Annoyance CRBE	Noise Sensitivity	Installation Importance
Noise sensitivity	Pearson correlation	0.333		
	p-value	0.001		
Installation importance	Pearson correlation	-0.277	-0.156	
	p-value	0.009	0.148	
Distance (km)	Pearson correlation	0.126	-0.045	0.010
	p-value	0.283	0.703	0.934

Table 4. Questions used in ANOVA model.

No.	Question
Q1	How would you rate this neighborhood overall as a place to live?
Q4	Do you think your neighborhood is quiet or noisy or about average?
Q30a	Do any children under age 6 live in your household?
Q32	What is the highest grade or year of schooling that you have completed?
Q33	How long have you lived at this address?
Q34	Do any members of this household work for the [Installation]?
Q35	Have any members of your family household ever served in the Armed Services?
Q36	Do any members of this household receive retirement or disability income as result of military or civilian service in the DoD?
Q38	About how old is your home or the building your residence is in?
Q39	How old are most of the windows in your residence?
Q42	To the best of your knowledge is your hearing normal?

Those who complained to the installation were significantly more annoyed by CRBE (mean annoyance = 4.7) in comparison to the matched-sample (mean annoyance = 2.3) (Table 5). It was found that respondents who report their neighborhood is noisy had a higher mean annoyance (4.5) than those who report their neighborhood is quiet or about average (3.3 and 2.7, respectively). It was also found that respondents who are receiving retirement or disability income have significantly lower mean annoyance to CRBE (3.2) in comparison to those who do not (3.8).

Regarding the importance of *Noise Sensitivity*, there was a high positive correlation between *Noise Sensitivity* and annoyance to CRBE. However, the effect of *Noise Sensitivity* was not significant in the ANOVA model that compared the annoyance of complainants and their neighbors (matched-sample). This finding suggests that *Noise Sensitivity* may be a characteristic of those who are highly annoyed, but not necessarily a characteristic of complainants.

Table 5. ANOVA output from annoyance to CRBE.

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
q4	2	67	9.72	0.0002
q33	3	67	2.86	0.0435
q36	1	67	5.94	0.0175
complainant	1	67	60.85	<.0001

Least Squares Means

Effect	complainant	q4	q33	q36	Estimate	Standard Error	DF	t Value	Pr > |t|
q4		1			3.3416	0.3054	67	10.94	<.0001
q4		2			2.7858	0.4108	67	6.78	<.0001
q4		3			4.4940	0.4106	67	10.94	<.0001
q33			1		4.6952	0.7950	67	5.91	<.0001
q33			2		2.9898	0.3572	67	8.37	<.0001
q33			3		3.5038	0.3029	67	11.57	<.0001
q33			4		2.9730	0.2793	67	10.64	<.0001
q36				1	3.1896	0.4055	67	7.87	<.0001
q36				2	3.8913	0.2909	67	13.38	<.0001
complainant	yes				4.7396	0.4074	67	11.64	<.0001
complainant	no				2.3413	0.2982	67	7.85	<.0001

Differences of Least Squares Means

Effect	complainant	q4	q33	q36	complainant	q4	q33	q36	Adjustment	Adj P
q4		1				2			Tukey-Kramer	0.1726
q4		1				3			Tukey-Kramer	0.0022
q4		2				3			Tukey-Kramer	0.0002
q33			1				2		Tukey-Kramer	0.1426
q33			1				3		Tukey-Kramer	0.4087
q33			1				4		Tukey-Kramer	0.1062
q33			2				3		Tukey-Kramer	0.4633
q33			2				4		Tukey-Kramer	0.9999
q33			3				4		Tukey-Kramer	0.2236
q36				1				2	Tukey-Kramer	0.0175
complainant	yes				no				Tukey-Kramer	<.0001

3.3.2 Annoyance to general military noise

The second analysis for this study was a test of differences in reported annoyance to general military noise (see Question 12b in Appendix B) between self-reported non-complainants (NC), first-time complainants (FC), and repeat complainants (RC). Respondents were grouped based on the answer to Questions 25f (*have you complained?*) and 25g (*how many times did you complain?*), and whether the respondent was grouped as a complainant or the matched-sample in the analysis above. For this analysis, NCs are respondents who self-report no complaints in the past 6 months and were previously grouped as matched-sample; FCs are respondents who report one complaint in the past 6 months or report no complaints and were previously grouped as a complainant; and RCs are

respondents who self-report more than one complaint in the past 6 months or were previously grouped as a repeat complainant.

Similar to the analysis in Section 3.3.1, an exploratory correlation analysis was done to examine the relationships between response variables and possible covariates (Table 6). The covariates considered included a composite *Noise Sensitivity* rating, composite installation importance rating, and distance of the respondent from the source.

It was found that *Noise Sensitivity* ($p < 0.001$) and *Installation Importance* ($p = 0.012$) were significantly correlated with annoyance to general military noise. Similar to the previous analysis, *Noise Sensitivity* and annoyance have a positive correlation, whereas installation importance and annoyance have a negative relationship. The concept of noise sensitivity was explored further to see if there was a significant difference in noise sensitivity between NC, FC, and RC. As the noise sensitivity variable was calculated as an average of several 5-point Likert scale questions, it had a range of 1-5. It was found that NC had the lowest average noise sensitivity rating (2.15), followed by first-time and RC (2.32 and 2.62, respectively). The difference between NC and RC was the only significant one ($p = 0.0495$). Table 6 lists the ANOVA output.

Next, an ANCOVA was run, which included the *Noise Sensitivity* covariate. However, this model was discarded and replaced with an ANOVA model because the relationship between the response variable and the continuous predictor was not entirely linear over the range of possible values of the predictor, which was a violation of a key assumption underlying the ANCOVA model. Tables 8, 9, and 10 list the output from the final ANOVA model; these results will be discussed in Section 3.3.2.

Table 6. Correlation analysis output for annoyance to general military noise.

Parameter	Correlation	Annoyance to Military Noise	Noise Sensitivity	Installation Importance
Noise sensitivity	Pearson correlation	0.457		
	p-value	<0.001		
Installation importance	Pearson correlation	-0.192	-0.116	
	p-value	0.012	0.113	
Distance (km)	Pearson correlation	-0.035	-0.084	-0.032
	p-value	0.662	0.266	0.682

Table 7. ANOVA output from noise sensitivity and complaint status.

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
Complaint	2	185	3.22	0.0423

Least Squares Means

Effect	Complaint	Estimate	Standard Error	DF	t Value	Pr > |t|
Complaint	first	2.3207	0.1673	188	13.87	<.0001
Complaint	none	2.1501	0.04599	14.5	46.75	<.0001
Complaint	repeat	2.6223	0.1969	189	13.32	<.0001

Differences of Least Squares Means

Effect	Complaint	Complaint	Estimate	Standard Error	DF	t Value	Pr > |t|	Adj P Adjustment
Complaint	first	none	0.1706	0.1726	189	0.99	0.3241	.5850
Complaint	first	repeat	-0.3016	0.2596	190	-1.16	0.2468	.4776
Complaint	none	repeat	-0.4722	0.1995	184	-2.37	0.0190	.0495

Table 8. ANOVA mixed procedure output from annoyance to general military noise.

The Mixed Procedure

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
q1	5	158	2.78	0.0196
q4	2	158	7.72	0.0006
q33	4	158	2.48	0.0460
q39	5	158	3.34	0.0068
Complaint	2	158	8.88	0.0002

Table 9. ANOVA least squares means output from annoyance to general military noise.

Least Squares Means

Effect	Complaint	q1	q4	q33	q39	Estimate	Standard Error	DF	t Value	Pr > |t|
q1		-8				4.2933	0.9638	158	4.45	<.0001
q1		1				2.6218	0.9389	158	2.79	0.0059
q1		2				1.6217	0.9463	158	1.71	0.0885
q1		3				3.6855	0.4355	158	8.46	<.0001
q1		4				2.9873	0.3769	158	7.93	<.0001
q1		5				3.4914	0.3833	158	9.11	<.0001
q4			1			2.7703	0.4189	158	6.61	<.0001
q4			2			2.6736	0.4558	158	5.87	<.0001
q4			3			3.9065	0.4639	158	8.42	<.0001
q33				-8		2.0390	1.2736	158	1.60	0.1114
q33				1		4.2005	0.7053	158	5.96	<.0001
q33				2		2.7811	0.3793	158	7.33	<.0001
q33				3		3.4646	0.3780	158	9.17	<.0001
q33				4		3.0989	0.3185	158	9.73	<.0001
q39					-8	3.5090	0.6059	158	5.79	<.0001
q39					1	3.3852	0.4143	158	8.17	<.0001
q39					2	3.0214	0.4699	158	6.43	<.0001
q39					3	3.7507	0.4596	158	8.16	<.0001
q39					4	2.6688	0.5703	158	4.68	<.0001
q39					5	2.3659	0.4686	158	5.05	<.0001
Complaint	first					3.1392	0.5415	158	5.80	<.0001
Complaint	none					2.2595	0.3985	158	5.67	<.0001
Complaint	repeat					3.9518	0.5454	158	7.25	<.0001

Table 10. ANOVA mixed procedure differences of least square means output from annoyance to general military noise.

The Mixed Procedure
Differences of Least Squares Means

ffect	Complaint	q1	q4	q33	q39	Complaint	q1	q4	q33	q39	Adjustment	Adj P
q1		-8					1				Tukey-Kramer	0.7946
q1		-8					2				Tukey-Kramer	0.3157
q1		-8					3				Tukey-Kramer	0.9909
q1		-8					4				Tukey-Kramer	0.7737
q1		-8					5				Tukey-Kramer	0.9631
q1		1					2				Tukey-Kramer	0.9672
q1		1					3				Tukey-Kramer	0.8347
q1		1					4				Tukey-Kramer	0.9983
q1		1					5				Tukey-Kramer	0.9164
q1		2					3				Tukey-Kramer	0.2393
q1		2					4				Tukey-Kramer	0.6789
q1		2					5				Tukey-Kramer	0.3342
q1		3					4				Tukey-Kramer	0.1631
q1		3					5				Tukey-Kramer	0.9860
q1		4					5				Tukey-Kramer	0.1666
q4			1					2			Tukey-Kramer	0.9098
q4			1					3			Tukey-Kramer	0.0006
q4			2					3			Tukey-Kramer	0.0016
q33				-8					1		Tukey-Kramer	0.5352
q33				-8					2		Tukey-Kramer	0.9760
q33				-8					3		Tukey-Kramer	0.7855
q33				-8					4		Tukey-Kramer	0.9105
q33				1					2		Tukey-Kramer	0.2858
q33				1					3		Tukey-Kramer	0.8431
q33				1					4		Tukey-Kramer	0.4881
q33				2					3		Tukey-Kramer	0.0808
q33				2					4		Tukey-Kramer	0.6843
q33				3					4		Tukey-Kramer	0.5518
q39					-8					1	Tukey-Kramer	0.9998
q39					-8					2	Tukey-Kramer	0.9342
q39					-8					3	Tukey-Kramer	0.9980
q39					-8					4	Tukey-Kramer	0.7306
q39					-8					5	Tukey-Kramer	0.3004
q39					1					2	Tukey-Kramer	0.6682
q39					1					3	Tukey-Kramer	0.8718
q39					1					4	Tukey-Kramer	0.5270
q39					1					5	Tukey-Kramer	0.0197
q39					2					3	Tukey-Kramer	0.3162
q39					2					4	Tukey-Kramer	0.9675
q39					2					5	Tukey-Kramer	0.4180
q39					3					4	Tukey-Kramer	0.2304
q39					3					5	Tukey-Kramer	0.0101
q39					4					5	Tukey-Kramer	0.9872
Complaint	first					none					Tukey-Kramer	0.0594
Complaint	first					repeat					Tukey-Kramer	0.3605
Complaint	none					repeat					Tukey-Kramer	0.0012

Similar to the previous analysis, there was a high positive correlation between noise sensitivity and annoyance to general military noise. This concept was further explored in the context of complainant status and it was found that there was a significant difference in the noise sensitivity of repeat complaints and NC. It appears that noise sensitivity increases as the number of self-reported complaints increase (Table 6).

It also appears that annoyance increases as the number of self-reported complaints increase. The data in Tables 8, 9, and 10 show that there was a significant difference (p = 0.0012) in the reported annoyance to general military noise between RC and NC. The mean annoyance was 4.0 and 2.3, respectively. There is also a nearly significant difference (p = 0.0594) in annoyance between FC and NC (3.1 vs. 2.3). It was again found that re-

spondents who report their neighborhood is noisy had a higher mean annoyance (3.9) than those who report their neighborhood is quiet or about average (2.8 and 2.7, respectively).

It was also found that the age of the windows in the respondents' dwellings had a significant impact on mean annoyance; those with windows 0-10 years old and 21-30 years old were significantly more annoyed on average (3.4 and 3.8, respectively) than those with windows 41 years of age or more (mean annoyance = 2.4). This finding is opposite to what was expected. One would expect that the older the window, the looser the frame and the higher probability of blast-induced rattle. Instead, the oldest windows were associated with the lower annoyance.

3.4 Discussion

3.4.1 Percent highly annoyed

Most noise surveys are typically analyzed in terms of the percentage of the population that is highly annoyed. For the 5-point annoyance scale, a response of 4 (*very annoying*) or 5 (*extremely annoying*) is considered HA. However, distilling the annoyance responses into binary responses of HA or not HA may hide important details. In hopes of better understanding the variance in human response to blast noise, the ANOVA analyses presented in this report looked at average annoyance responses across all five annoyance categories.

For purposes of comparison with previous studies, it is important to have a standardized method for reporting annoyance. Tables 11 and 12 list the %HA to CRBE, and general military noise.

Table 11. Percent highly annoyed matched-sample vs. complainants.

CRBE	Data Points (N)	Mean Annoyance (1-5)	St Dev Annoyance (1-5)	% Highly Annoyed
Matched-sample	77	2.1	1.5	25%
Complainants	21	4.4	1.2	90%

Table 12. Percent highly annoyed between NC, FC, and RC.

General Military Noise	Data Points (N)	Mean Annoyance (1-5)	St Dev Annoyance (1-5)	% Highly Annoyed
Non-complainant	153	2.5	1.4	23%
First complainant	11	3.5	0.8	45%
Repeat complainant	12	4.5	1.4	92%

It is interesting that not all complainants report high annoyance to the CRBE. A further examination reveals that two of the complainants report an annoyance response of 1 (*not at all annoying*). This may suggest that some of the residents that call the installation are inquiring about the noise rather than complaining. This finding is consistent with the literature that has looked at the emotional content of complainants (Luz, Raspet, and Schomer 1983; Hodgdon 2009). Removal of the two respondents who reported an annoyance of 1 from the complaint group would increase the %HA to 100%, as one might expect.

The %HA given for the matched sample is dependent on whether the analysis includes respondents who were home at the time of the CRBE, but did not recall the CRBE. If one assumes that those who were home during the time of the CRBE, but did not recall the CRBE were "not at all annoyed," then the 25% of the NC or matched-sample were HA. However, if the 36 respondents that were home but did not recall hearing blast events are removed, this percentage would be 46%. Both of these measures of %HA for the matched-sample are significantly different from the complainant group, but the differences between 25%HA and 46%HA are also significant and might suggest that complainants could be used to capture a rise in the community annoyance.

In general, the findings of the ANOVA are similar to the descriptive statistics listed in Tables 11 and 12. Complainants are more annoyed than their non-complaining neighbors. Both the mean annoyance and %HA increase as complaint status increases from non-complainant to first-time to repeat complainant.

3.4.2 Installation management of complaints

A comprehensive set of recommendations or guidelines for managing complaints at installations will require two additional pieces of information: (1) complaint risk prediction from the number, timing, and level of discrete blast events, (2) determination of whether complaints or a localized (in time and space) group of complaints can be used to predict an increase in the localized community annoyance. Studies that look at the correlation between complaints and recent blast noise events, and that capture the variance in the annoyance response per local area have been conducted and are currently under analysis. In the interim, it is recommended that all installations use standardized complaint questionnaires when people "call in" or file complaints with the installation, to establish larger complaint similarities and differences across DoD. Furthermore, installations should follow

the noise complaint guidelines published in the Tri-Services Community and Environmental Noise Primer (CHPPM 2005).

From this study, it appears there is evidence that some residents who contact the installation are merely inquiring about the noise rather than complaining. Questions should be added to the standardized complaint questionnaire to make this determination. Oftentimes, residents contact the installation to be sure that the noise they heard was from the installation and not coming from something or someone else. Such inquiries may provide useful feedback to the installation that the noise was loud enough to be noticeable, but may need to be used differently from a resident's feedback that characterizes the noise as unacceptably loud and/or highly annoying. Use of inquiries as a part of noise management should be further investigated before a conclusive recommendation is made.

Installations should also create separate tallies of RC and FC or occasional complainants. The findings from this study are in agreement with the literature that has found that there are a considerable number of complainants from a few individuals. Wiechen et al. (2002) found that 70% of complainants complained more than once, and Hume, Terranova, and Thomas (2001) found that 41% of complainants were from RC. Repeat complaints may be an extension of the original complaint and an indication that the original complaint was unsatisfactorily addressed. As suggested by Luz, Raspet, and Schomer (1983), complaints should be dealt with in a timely manner to reduce the risk of having a complaint snowball into more formal grievance (e.g., Congressional inquiries and lawsuits), which undoubtedly will result in testing and training restrictions.

4 Conclusions and Recommendation

4.1 Conclusions

This study looked at whether there are significant differences in reported annoyance to CRBE and general military noise between complainants and their non-complaining neighbors. It was found that complainants were significantly more annoyed to both noise sources than their non-complaining neighbors. The larger question of whether complaints can be used as a surrogate measure of annoyance or used to predict a rise in local (in both space and time) annoyance is a topic of further investigation. In general, it was found that the majority of respondents report that their neighborhood is a very nice (good or excellent) place to live and that the noise in their neighborhoods ranges between quiet and average. This finding includes complainants, but not necessarily repeat complainants or those who were highly annoyed. Noise sensitivity was also found to be highly correlated with those who report high annoyance to military and blast noise, and the degree of sensitivity to noise increased as the number of self-reported complaints increased.

There are three implications from the current findings that are important for future noise management policy. The first involves a modification to the doctrine issued by the Federal Interagency Committee on Noise (FICON 1992). In its endorsement of the Schultz curve as the primary measure of the effects of noise on communities, FICON asserted that the existence of noise complaints does not mean there is significant annoyance, and, conversely, the absence of noise complaints does not mean that annoyance is absent. The current findings suggest that people who complain about a specific sound event are much more annoyed than those who do not. Thus, the FICON position should be modified to reflect that complaints are an indicator of individual high annoyance. The converse about the absence of complaints not being used as an indicator should be retained; there are often situations where annoyed people either do not know how to complain, or feel that complaints would be ineffective.

The second policy implication relates to the opportunity for after-action reports on environmental noise assessments. The concept of the after-action report is engrained in Army culture, and after-action reports are used to derive “lessons learned.” Currently, the Army Public Health Com-

mand (formally CHPPM), the agency responsible for most of the environmental noise assessments published by the Army, does not write after-action reports on its noise assessments. The finding that people who complain also tend to report being highly annoyed raises the possibility that complaints could be used in post-construction assessments. As noted earlier, the Schultz curve predicts the percentage of highly annoyed people, not average annoyance. Specifically, highly annoyed is defined as a person whose annoyance report falls into the top 28% of the scale. In the current study, 90% of the complainants were highly annoyed.

The third policy implication relates to the finding that personal and situational variables influence complaints in ways comparable to the way these variables influence annoyance. This term, "situational and personal variables," is taken from an influential meta-analysis of international social surveys of noise annoyance published by Fields (1993). Fields concluded that annoyance is related to the amount of isolation from sound at home and to five attitudes: (1) fear of danger from the noise source, (2) noise prevention beliefs, (3) general noise sensitivity, (4) beliefs about the importance of the noise source, and (5) annoyance with non-noise impacts of the noise source.

In designing the survey questions, consideration was given to all six of these variables. Two of them were dismissed as inapplicable (fear of danger and annoyance with non-noise impacts). Fear of danger is often found in the language used by complainants about military aircraft noise, but seldom in complaints about blast noise (Luz, Raspet, and Schomer 1983). Annoyance with non-noise impacts might be relevant, such as in the case of an outdoorsman who is upset with the range restrictions on the use of game lands, but would be too idiosyncratic to be captured in a small set of questions. Belief that the noise maker had a choice about preventing the noise does appear in the language used by blast noise complainants (Luz, Raspet, and Schomer 1983), and the original version of the questionnaire included questions about this variable. However, after consultation with upper management and legal counsel, the decision was made to drop those questions as too politically-sensitive.

This leaves beliefs about the importance of the noise source, noise sensitivity, and isolation from sound in the home. Both importance of the noise source and noise sensitivity were significantly related to complaints. The observation that the noise sensitivity variable was statistically significant —with a mere three question composite— suggests that this line of ques-

tioning could be expanded. The most widely-used index of noise sensitivity, the Weinberg Noise Sensitivity Index, is based on 20 questions. Current plans call for using the Weinberg Index with the subjects of the in-situ study.

Four of the questions were designed to look for isolation from sound in the home, but those questions had poor statistical performance. Only one of those questions (age of windows) demonstrated a statistically significant relationship, and the relationship was opposite what was expected.

4.2 Recommendation

The finding on the importance of the noise source demonstrates the value of community outreach, such as installation Armed Forces Day events and Public Affairs press releases. The role of noise sensitivity suggests that extra effort should be made to educate noise-sensitive people in advance of their moving into areas close to ranges. The most direct way to provide such education is to make the installation noise contour maps available to the general public through local planning agencies.

Acronyms and Abbreviations

Term	Definition
ADNL	A-weighted Day-Night Level
AFB	Air Force Base
AICUZ	Air Installation Compatible Use Zone
ANCOVA	Analysis of Covariance
ANOVA	Analysis of Variance
ANSI	American National Standards Institute
AR	Army Regulation
CDNL	C-weighted yearly average Day-Night Level
CEERD	US Army Corps of Engineers, Engineer Research and Development Center
CERL	Construction Engineering Research Laboratory
CHABA	National Academy of Sciences/National Research Council Committee on Hearing, Bioacoustics and Biomechanics
CHPPM	US Army Center for Health Promotion and Preventive Medicine (now the Army Public Health Command)
CRBE	Complaint-Referenced Blast Events
CS	Complaint Survey
DDESB	DoD Explosives Safety Board
DNL	day-night level
DoD	US Department of Defense
DOL	US Department of Labor
ERDC	Engineer Research and Development Center
FAA	Federal Aviation Administration
FC	first-time complainants
FICON	Federal Interagency Committee on Noise
GAO	US Government Accountability Office
GPO	US Government Printing Office
HA	highly annoyed
HQDA	Headquarters, Department of the Army
ICBEN	International Commission on the Biological Effects of Noise
I-INCE	International Institute of Noise Control Engineering
IRB	(Pennsylvania State University Office of Research Protections) Institutional Review Board
MIL-STD	Military Standard
NASA	National Aeronautics and Space Administration
NC	non-complainants
NSN	National Supply Number
NSWC/DL	Naval Service Weapons Center, Dahlgren, VA
OMB	Office of Management and Budget
OSHA	Occupational Safety and Health Administration

Term	Definition
RC	repeat complainants
SAR	Same As Report
SAS	An integrated system of software products provided by SAS Institute Inc., originally “Statistical Analysis System”
SERDP	Strategic Environmental Research and Development Program
SF	standard form
SI	Systeme Internationale
SPL	Sound Pressure Level
SR	Special Report
TR	Technical Report
UK	United Kingdom
US	United States
USEPA	US Environmental Protection Agency

References

Aiken, L.R. 1997. Questionnaires and inventories. New York: John Wiley and Sons, Inc.

Anderson, A.B., A. Basilevsky, and D. P. J. Hum. 1983. Measurement: Theory and techniques. Handbook of survey research. Orlando, FL: Academic Press, pp 231-287 in

Ashman, C. 2007. An investigation into the influence of non-auditory factors on community response to aircraft noise. School of Engineering. PLACE: Cranfield University, p 156.

Avery, G. C. 1982. Comparison of telephone complaints and survey measures of noise annoyance. Journal of Sound and Vibration 82(2):215-225.

Borsky, P. N. 1979. Sociopsychological factors affecting the human response to noise exposure. Otolaryngol. Clin. N. Am. 12(3):521-535.

Botteldooren, D., Verkeyn, A., and Lercher, P. (2003). A fuzzy rule based framework for noise annoyance modeling. Journal of the Acoustical Society of America 114(3):1487-1498.

Brink, M., and J.-M. Wunderli. 2010. A field study of the exposure-annoyance relationship of military shooting noise. The Journal of the Acoustical Society of America 127(4):2301-2311.

Bucci, B. A., and J. S. Vipperman. 2007. Performance of artificial neural network-based classifiers to identify military impulse noise. Journal of the Acoustical Society of America 122(3):1602-1610.

Federal Interagency Committee on Noise (FICON). August 1992. Federal agency review of selected airport noise analysis issues. Washington, DC: FICON.

Fidell, S. 2003. The Schultz curve 25 years later: A research perspective. Journal of the Acoustical Society of America 114(6):3007-3015.

Fields, J. M. 1993. Effect of personal and situational variables on noise annoyance in residential areas. Acoustical Society of America 93(5):2753-2763.

———. 1997. Reactions of residents to long term sonic boom noise environment. Langley, Hampton, VA: National Aeronautic and Space Administration (NASA), http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19970023685_1997038340.pdf

Fields, J. M., R. G. De Jong., T. Gjestland, I. H. Flindell, R. F. S. Job, S. Kurra, P. Lercher, M. Vallet, and T. Yano. 2001. Standardized general-purpose noise reaction questions for community noise surveys: Research and a recommendation. Journal of Sound and Vibration 242(4):641-679.

Flindell, I. H., and I. J. Witter. 1999. Non-acoustical factors in noise management at Heathrow Airport. Noise Control Engineering Journal 1(3):27-44.

Gillen, D. W., and T. J. Levesque. 1994. A socio-economic assessment of complaints about airport noise. Transportation Planning and Technology 18(1):45-55.

Guski, R. 1977. An analysis of spontaneous noise complaints. Environmental Research 13(2):229-236.

Hatfield, J., R. F. S. Job, N. Carter, P. Peploe, R. Taylor, and S. Morell. 1998. Attitude-mediated reaction to noise influences physiological responses: Evidence supporting causality. Paper No. 440. Inter-Noise'98. 2:1163-1166.

Headquarters, Department of the Army (HQDA). 13 December 2007. Army Regulation (AR) 200-1. Environmental protection and enhancement. Washington, DC: HQDA, http://www.apd.army.mil/pdffiles/r200_1.pdf

Hodgdon, K.. E. T. Nykaza, T. Gaugler, P. Krecker, and G. Luz . 2010. Personal Interview Protocol Report. Applied Research Laboratory, State College, PA, p. 46, http://www.dtic.mil/dtic/tr/fulltext/u2/a544876.pdf

Hodgdon, K. K., Trent Gauglerb, E. T. Nykaza, P. Krecker, and George Luz. April 2009. Investigation of community attitudes toward blast noise, www.serdp.org/Research/upload/SI-1546.pdf

Hume, K., D. Terranova, and C. Thomas. 2001. Can complaints about aircraft noise be used as an index of annoyance? InterNoise: The 2001 International Congress and Exhibition on Noise Control Engineering. The Hague, The Netherlands, pp 27-30.

————. 2002. Complaints and annoyance caused by aircraft operations: Temporal patterns and individual bias. Noise & Health 4(15):45-55.

Hume, K., H. Morley, and C. Thomas. 2003b. A review of complaints and social surveys at Manchester Airport: Attitudes to aircraft annoyance around airports. EEC/SEE/2003/004. Manchester Metropolitan University, UK: Eurocontrol Experimental Centre, http://www.eurocontrol.int/eec/gallery/content/public/document/eec/report/2003/024_Complaints_and_Social_Surveys_at_Manchester_Airport.pdf

Hume, K., M. Gregg, C. Thomas, and D. Terranova. 2003a. Complaints caused by aircraft operations: An assessment of annoyance by noise level and time of day. Journal of Air Transport Management 9(3):153-160.

Luz, G. A., R. Raspet, and P. D. Schomer. 1983. An analysis of community complaints to noise. The Journal of the Acoustical Society of America 73(4):1229-1235.

Mabrey, J. L., and R. B. Carey 1980. An analysis of community complaints to Air Force aircraft noise. Wright Patterson AFB, OH: Air Force Aerospace Medical Research Laboratory.

Maziul, M., R. F. S. Job, and J. Vogt. 2005. Complaint data as an index of annoyance: theoretical and methodological issues. Noise & Health 7(28):17-27.

Morley, H., and K. Hume. 2003. Socio-economic status of aircraft noise complainers. Proceedings of the 8th International Congress on Noise as a Public Health Problem. Rotterdam, The Netherlands, pp 274-275.

National Research Council, Committee on Hearing, Bioacoustics, and Biomechanics (CHABA). 1996. Community response to high-energy impulsive sounds: An assessment of the field since 1981. Washington, DC: National Academies Press, p 63, http://www.nap.edu/catalog.php?record_id=9135#toc

Nykaza, E. T., G. Luz, and L. Pater. 2008a. Field research on the assessment of community impacts from large weapons noise. Foxwoods, CT: International Commission on the Biological Effects of Noise (ICBEN), p 8.

Nykaza, E. T., L. L. Pater, and G. A. Luz. 2008b. Improved procedure for correlating blast noise events with complaint logs at US Army installations. Noise Control Engineering Journal 56(6):451-459.

Nykaza, E. T., L. L. Pater, R. H. Melton, and G. A. Luz. 2009. Minimizing sleep disturbance from blast noise producing training activities for residents living near a military installation. The Journal of the Acoustical Society of America 125(1):175-184.

Nykaza, E., L. Pater, S. Fidell, and P. Schomer. 2005. Community response to blast noise. NOISE-CON 2005, Minneapolis, Minnesota, p. 5.

Pater L.L., E. T. Nykaza, G. A. Luz, A. A. Atchley, K. K. Hodgdon, R. Baumgartner, and P. Rathbun. 2007. An investigation of community attitudes toward blast noise: Methodology. ERDC/CERL SR-07-24. Champaign, IL: Engineer Research and Development Center, Construction Engineering Research Laboratory (ERDC-CERL), http://www.cecer.army.mil/techreports/ERDC-CERL_SR-07-24/ERDC-CERL_SR-07-24.pdf

Pater, L. L. 1976. Noise abatement program for explosive operations at NSWC/DL. Seventeenth Explosives Safety Seminar of the DDESB, Denver, CO, p 14.

———. 2008. BNOISE2: Blast Noise Impact Assessment. ERDC "Ongoing Research" Fact Sheet. Engineer Research and Development Center (ERDC), http://www.erdc.usace.army.mil/pls/erdcpub/docs/erdc/docs/ERDCFactSheet_Research_BNOISE2.pdf

Perkins, B., and W. Jackson. February 1964. Handbook for prediction of air blast focussing. Report No. 1240. Aberdeen proving Ground, MD: Army Ballistic Research Laboratory, http://www.dtic.mil/dtic/tr/fulltext/u2/602112.pdf

Schomer, P. 1985. Assessment of community response to impulsive noise. Acoustical Society of America 77(2):16.

Schomer, P. D., and J. W. Sias. 1998. On spectral weightings to assess human response, indoors, to blast noise and sonic booms. Noise Control Engineering Journal 46(2):57-71.

Schomer, P., R. J. Goff, and L. M. Little. 1976. Statistics of amplitude and spectrum of blasts propagated in the atmosphere. Acoustical Society of America. 63(5):13.

Schultz, T. 1978. Synthesis of social surveys on noise annoyance. Acoustical Society of America 64(2):29.

Tracor, Inc. 1970. Community reactions to airport noise. Washington, DC: US Government Printing Office (GPO).

———. 1972. Community reaction to aircraft noise around smaller city airports. Langley Research Center, Hampton, VA: NASA.

US Army Center for Health Promotion and Preventive Medicine [now the Army Public Health Command [USAPHC]] (CHPPM) (2002). Estimated annual cost of noise to the Army
http://chppm-www.apgea.army.mil/enp/costs.htm

———. 2005. Noise management- A primer on facilitating community involvement and communication with the public. Aberdeen Proving Ground, MD: USAPHC (formerly CHPPM).

US Department of Defense (DoD). 1997. Department of defense design criteria standard: Noise limits. MIL-STD-1474D. Washington, DC: DoD.

US Department of Labor (DOL). 1983. Department of labor occupational noise exposure standard. CFR29 1910.95. Washington, DC: DOL, Occupational Safety, and Health Administration (OSHA).

US Environmental Protection Agency (USEPA). 1974. Information on levels of environmental noise requisite to protect public health and welfare with an adequate margin of safety. Washington, DC: USEPA, p 173.

US Government Accountability Office (GAO). 2000. Aviation and the environment: Results from a survey of the nation's 50 busiest commercial service airports. GAO/RCED-00-222. Washington, DC: GAO.

———. June 2002. Military training: DoD lacks a comprehensive plan to manage encroachment on training ranges. GAO-02-614. Washington, DC: GAO, http://www.gao.gov/assets/240/234831.pdf

Vogt, J., and M. Kastner. 1999. Sustainable airport development: Investigating psychological and health-related noise effects and potential counter-measures. Proceedings of the 1999 International Congress on Noise Control Engineering. 106:1223-1226. Fort Lauderdale, FL: International Institute of Noise Control Engineering (I-INCE).

von Gierke, H. 1977. Guidelines for preparing environmental impact statements on noise. Report of Working Group 69, Committee on Hearing, Bio-Acoustics, and Biomechanics, National Academy of Sciences/National Research Council. Washington, DC: National Academy of Sciences.

Wiechen, C. M. A. G. v., E. A. M. Frannsen, R. G. d. Jong, and E. Lebret. 2002. Aircraft noise exposure from Schiphol Airport: A relation with complainants. Noise & Health 5(17):23-34.

Wirth, K. E., M. Brink, and C. Schierz. 2003. Aircraft noise annoyance around the airport Zurich-Kloten. Proceedings of the 8th International Congress on Noise as a Public Health Problem. Rotterdam, The Netherlands, pp 351-353.

Appendix A: Noise Metrics Definitions

L, L_A, L_C Sound Pressure Level (Flat-, A- and C-Weighted)

The noise weighting (flat, A, C) is the prescribed frequency response provided in a sound level meter so that the instrument approximates the sensitivity of the ear at given frequencies and levels. Flat weighting employs response characteristics that are essentially independent of frequency over the specified range (Harris 1991).

The A-weighting curve is roughly the inverse of the 40-phon equal loudness contour, and was designed to mimic the human ear's response to sound of that loudness. The 40-phon curve represents the level of a tone that is necessary at each frequency to be equally as loud as a 1 kHz sound pressure level (SPL) tone at 40 dB (Peterson and Gross 1974). It was not designed to evaluate loudness significantly greater than 40 phon line curve and does not accurately characterize noise perception above that level. It is also not designed to evaluate noise that contains significant low-frequency content (Leventhall 2003), as the A-weighting function has a sharp roll-off at low frequencies.

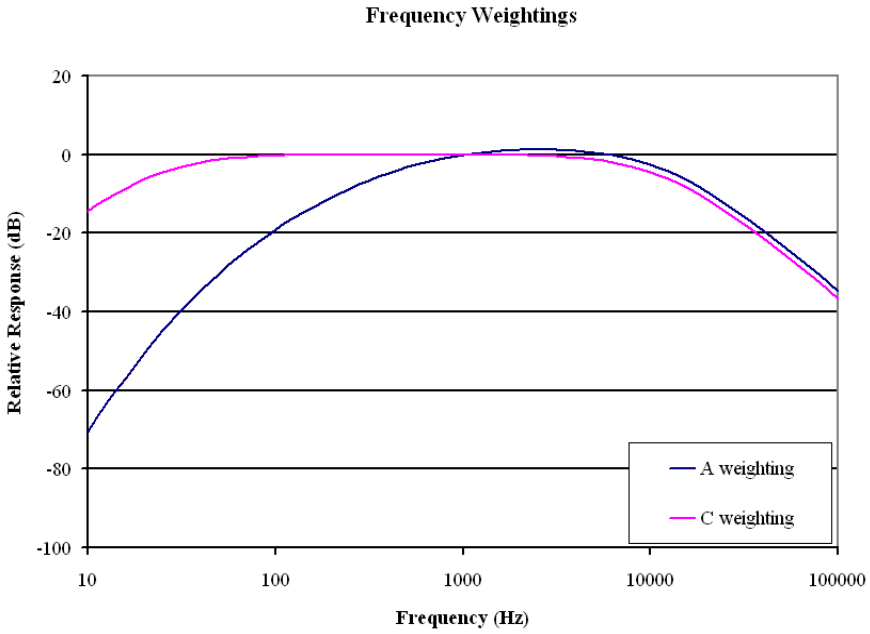
The C-weighting network is appropriate for louder sounds as it approximates the human ear's response to sound at the 90 phon contour level (Figure A1) (Norton 1989). The C-weighting response is fairly uniform from 50 to 5000 Hz (Harris 1991).

L_{dn} Day-Night Average Sound Level (Barber 1992)

This is an L_{eq} with an extra 10 dB weighting for noise occurring during the nighttime period from 10 p.m. to 7 a.m. The nighttime penalty is intended to account for the extra annoyance caused to communities by nighttime noise.

L_{eq} Equivalent Sound Pressure Level (Barber 1992)

L_{eq} provides a single number measure of a time varying noise over a given period. The standard L_{eq} uses the A-weighting. It is the A-weighted energy of the sound level averaged over the specified measurement period. It can be defined as the continuous noise that would have the same acoustic power as the real measured noise over the same period.



Source: Peterson and Gross (1974).

Figure A1. A- and C-frequency weighting characteristics.

L_{eq} can be defined mathematically as:

$$L_{eq} = 10\log\left\{1/T \int_0^T \left(p_A(t)/p_o\right)^2 dt\right\}$$

where:

T = total time
$pA(t)$ = the instantaneous value of the sound pressure
po = the reference pressure.

In this form, it is suitable for manipulation in a sound level meter.

If the overall sound during the time T can be adequately represented by a limited number of discrete levels, then:

$$L_{eq} = 10\log\frac{t_1 \log^{-1}\frac{L_1}{10} + t_2 \log^{-1}\frac{L_2}{10} + \ldots t_n \log^{-1}\frac{L_n}{10}}{T}$$

Where L_1 ... etc. are the A-weighted sound pressure levels and $t1$ ... etc. are their durations. In this form, it is suitable for manual manipulation.

References

Barber, A. 1992. Handbook of noise and vibration control. Oxford UK: Elsevier Science Publishers LTD.

Harris, C. M. 1991. Handbook of acoustical measurements and noise control. Blacklick, OH: McGraw Hill Inc.

Leventhall, G. A. 2003. Review of published research on low frequency noise and its effects. Report for Defra (UK Department for Environment, Food and Rural Affairs), http://docs.wind-watch.org/leventhall-defra-lowfreqnoise.pdf

Norton, M. P. 1989. Fundamentals of noise and vibration analysis for engineers. Cambridge, UK: Cambridge University Press.

Peterson, A. P. G., and E. E. Gross, Jr. 1974. Handbook of noise measurement. 7th ed. Concord, MA: General Radio Corp.

Appendix B: Complaint Survey Instrument

Complaint Phone Survey

An Investigation of Community Attitudes towards Noise

Cover Page

October 17 2008

Part 1: Respondent Characteristics, General Attitudes Toward Neighborhood and Noise Sensitivity

1) How would you rate this neighborhood overall as a place to live? [READ LIST]
   1 Terrible
   2 Poor
   3 Average
   4 Good
   5 Excellent
   D Don't know
   R Refused

2) What are some of the things you LIKE most about living in this neighborhood?

   _____

3) What are some of the things you DISLIKE most about living in this neighborhood?

   _____

4) While we are interested in all neighborhood conditions, we are particularly interested in the various kinds of noises that people hear in this area. Do you think your neighborhood is quiet or noisy or about average?

   1 Quiet (FOLLOW-UP: Why do you say that?)
   2 Averag
   3 Noisy (FOLLOW-UP: Why do you say that?)
   D Don't know
   R Refused

5) What kinds of noise do you hear in this neighborhood? RECORD RESPONSES

   _____

   _____

6a) Now I am going to read a list of common neighborhood noises. Please rate the degree of annoyance, if any, which you experience from each noise source. For each noise source, please tell me if you find it not at all annoying, slightly annoying, moderately annoying, very annoying, or extremely annoying.

   Barking dogs

   1 Not at all annoying
   2 Slightly annoying

3 Moderately annoying
4 Very annoying
5 Extremely annoying
D Don't know
R Refused

6b) Playing children

(IF NECESSARY: Do you find it not at all annoying, slightly annoying, moderately annoying, very annoying, or extremely annoying?)

1 Not at all annoying
2 Slightly annoying
3 Moderately annoying
4 Very annoying
5 Extremely annoying
D Don't know
R Refused

6c) Thunder

(IF NECESSARY: Do you find it not at all annoying, slightly annoying, moderately annoying, very annoying, or extremely annoying?)

1 Not at all annoying
2 Slightly annoying
3 Moderately annoying
4 Very annoying
5 Extremely annoying
D Don't know
R Refused

7) Do you enjoy fireworks at organized events?

1 Yes
2 No
D Don't know
R Refused

8) Please rate the degree of annoyance, if any, which you experience from listening to fireworks at organized events. (Please tell me if you find it not at all annoying, slightly annoying, moderately annoying, very annoying, or extremely annoying.)

1 Not at all annoying
2 Slightly annoying

3 Moderately annoying
4 Very annoying
5 Extremely annoying
D Don't know
R Refused

9) Do you enjoy amateur fireworks set off by neighbors in your community?

1 Yes
2 No
D Don't know
R Refused

10) Please rate the degree of annoyance, if any, which you experience from listening to amateur fireworks in your community. (Please tell me if you find it not at all annoying, slightly annoying, moderately annoying, very annoying, or extremely annoying.)

1 Not at all annoying
2 Slightly annoying
3 Moderately annoying
4 Very annoying
5 Extremely annoying
D Don't know
R Refused

11a) Other residents in this area have mentioned the following types of noises. Please rate the degree of annoyance you experience in this neighborhood from each source. For each noise source, please tell me if you find it not at all annoying, slightly annoying, moderately annoying, very annoying, or extremely annoying.

Street traffic
1 Not at all annoying
2 Slightly annoying
3 Moderately annoying
4 Very annoying
5 Extremely annoying
D Don't know
R Refused

11b) Aircraft

(IF NECESSARY: Do you find it not at all annoying, slightly annoying, moderately annoying, very annoying, or extremely annoying?)

1 Not at all annoying
2 Slightly annoying
3 Moderately annoying
4 Very annoying
5 Extremely annoying
D Don't know
R Refused

12a) Other residents in the area have mentioned military noise. Do you hear military noise?

1 Yes → What types of military noise do you hear? [RECORD RESPONSES]
2 No → SKIP TO QUESTION 13
D Don't know → SKIP TO QUESTION 13
R Refused → SKIP TO QUESTION 13

12b) How would you rate the degree of annoyance, if any, you experience from military noise in this neighborhood? Do you find military noise to be not at all annoying, slightly annoying , moderately annoying, very annoying, or extremely annoying?

1 Not at all annoying
2 Slightly annoying
3 Moderately annoying
4 Very annoying
5 Extremely annoying
R No opinion

PART 2: Awareness and Recall of Specific Noise Event that Triggered a Complaint

These next questions ask about whether you recall hearing any noise while you were at home on [day of the week/date]. First, we need to find out when you were around home on that day.

13) Were you home on [day of the week/date], during [portion of the day of noise event]?

1	Yes	
2	No	→ Skip to Question 25
D	Don't know	→ Skip to Question 25
R	Refused	→ Skip to Question 25

14) While you were around home on [day of week/date] do you recall hearing any loud noises from [NAME OF INSTALLATION]?

1	Yes	
2	No	→ Skip to Question 25
D	Don't know	→ Skip to Question 25
R	Refused	→ Skip to Question 25

14a) What type of noise did you hear?

_____

15) About what time of the day did you hear the noise from [NAME OF INSTALLATION]?

_____:_____	AM or PM	→ Skip to Question 17
D	Don't know	→ Skip to Question 16
R	Refused	→ Skip to Question 16

16) [If R can't recall specific time, ask if it was early morning, mid-morning, late morning, early afternoon, mid-afternoon, late afternoon, early evening, mid evening, late evening. Record response below]

1	early morning
2	mid morning
3	late morning
4	early afternoon
5	mid afternoon
6	late afternoon
7	early evening
8	mid evening

9 late evening
D Don't know
R Refused

17) Were you inside the home or outside of your home when you heard the noise from [NAME OF INSTALLATION] on [day of week/date]?
1 Inside home
2 Outside home
3 Don't recall
D Don't know
R Refused

18) What were you doing at the time you heard the noise on that day?
1 Quiet activity such as relaxing or sleeping
2 Eating a meal or reading
3 Watching TV, listening to music or talking
4 Using appliances, power tools or lawn equipment
5 Other (Specify)
D Don't know
R Refused

19) Was the noise from [NAME OF INSTALLATION] you heard around home on [day of week/date] not at all annoying, slightly annoying, moderately annoying, very annoying, or extremely annoying?
1 Not at all annoying
2 Slightly annoying
3 Moderately annoying
4 Very annoying
5 Extremely annoying
D Don't know
R Refused

20) Was the noise from [NAME OF INSTALLATION] you heard around home on [day of week/date] not at all intrusive, slightly intrusive, moderately intrusive, very intrusive, or extremely intrusive?
1 Not at all intrusive
2 Slightly intrusive
3 Moderately intrusive
4 Very intrusive
5 Extremely intrusive
D Don't know
R Refused

21) Did you experience any rattle or vibration in your home from a noise from [NAME OF INSTALLATION] on [day of week/date]?

1 Yes
2 No - → Skip to Question 24
D Don't know- → Skip to Question 24
R Refused- → Skip to Question 24

22) What structures in your house rattled or vibrated on that day?

1 Windows
2 Walls
3 Shelves
4 China
5 Small decorative items, such as "bric a brac" or "knick knacks'
6 Other -→ Please specify _____
D Don't know
R Refused

23) Did the rattle or vibrations interfere with your ability to talk with others or hear conversations on that day?

1 Yes
2 No
D Don't know
R Refused

24a) Did the noise from [NAME OF INSTALLATION] you heard on [day of week/date] startle you or make you jump?

1 Yes
2 No
D Don't know
R Refused

24b) Did the noise frighten you?

1 Yes
2 No
D Don't know
R Refused

24c) Did the noise cause you to feel irritable or edgy?

1 Yes

2 No
D Don't know
R Refused

24d) Did the noise make you become tense or nervous

1 Yes
2 No
D Don't know
R Refused

Part 3: General Attitudes and Characteristics of Residence

25A) I'm going to read several statements. For each statement, please tell me if you strongly disagree, somewhat disagree, neither agree nor disagree, moderately agree or strongly agree.

I believe that people have a hard time getting used to noise

1 Strongly disagree
2 Somewhat disagree
3 Neither agree nor disagree
4 Moderately agree
5 Strongly agree
D Don't know
R Refused

25B) I believe that people get used to road traffic noise

(IF NECESSARY: Do you strongly disagree, somewhat disagree, neither agree nor disagree, moderately agree or strongly agree?)

1 Strongly disagree
2 Somewhat disagree
3 Neither agree nor disagree
4 Moderately agree
5 Strongly agree
D Don't know
R Refused

25C) I believe that with time most people adapt to noise

(IF NECESSARY: Do you strongly disagree, somewhat disagree, neither agree nor disagree, moderately agree or strongly agree?)

1 Strongly disagree
2 Somewhat disagree
3 Neither agree nor disagree
4 Moderately agree
5 Strongly agree
D Don't know
R Refused

25D) I believe that with time I can adapt to noise

(IF NECESSARY: Do you strongly disagree, somewhat disagree, neither agree nor disagree, moderately agree or strongly agree?)

1 Strongly disagree
2 Somewhat disagree
3 Neither agree nor disagree
4 Moderately agree
5 Strongly agree
D Don't know
R Refused

25E) I believe that with time I can get used to even the loudest noise

(IF NECESSARY: Do you strongly disagree, somewhat disagree, neither agree nor disagree, moderately agree or strongly agree?)

1 Strongly disagree
2 Somewhat disagree
3 Neither agree nor disagree
4 Moderately agree
5 Strongly agree
D Don't know
R Refused

25F) During the past 6 months, have you or anyone else in your household complained to [NAME OF INSTALLATION] about military noise in your neighborhood?

1 YES
2 NO → Go to Question 26
D Don't know → Go to Question 26
R Refused → Go to Question 26

25G) About how many times have you or another member of your household complained in the past 6 months? Would you say once, 2 or 3 times, 4 to 6 times, or more than 6 times?

1 Once
2 2 or 3 times
3 4 to 6 times
4 More than 6 times
D Don't know
R Refused

26) How would you rate the importance of [NAME OF INSTALLATION] for the economic health of your town and county? Is it not at all important, slightly important, moderately important, very important, or extremely important?

1 Not at all important
2 Slightly important
3 Moderately important
4 Very important
5 Extremely important
D Don't know
R Refused

27) How would you rate the importance of [NAME OF INSTALLATION] for public health in your town and county? Is it not at all important, slightly important, moderately important, very important, or extremely important?

1 Not at all important
2 Slightly important
3 Moderately important
4 Very important
5 Extremely important
D Don't know
R Refused

28) How would you rate the importance of Federal funding to your local school district from the [NAME OF INSTALLATION]? Is it not at all important, slightly important, moderately important, very important, or extremely important?

1 Not at all important
2 Slightly important
3 Moderately important
4 Very important
5 Extremely important

D Don't know
R Refused

29) One role that military installations are expected to fulfill is to serve as environmental caretakers of Federal lands, protecting rare and endangered species and, when appropriate, providing opportunities for recreation, such as hunting and fishing and outdoor activities. How would you rate the job [NAME OF INSTALLATION] has done in caring for this environment? Have they been . . . . [READ LIST]

1 Terrible
2 Poor
3 Average
4 Good
5 Excellent
D Don't know
R Refused

30) OK, we are almost finished. I just have a few more questions about your residence.

Including yourself, how many people live in your household?

30a) [IF >1 in household:]
Do any children under age 6 live in your household?
1 Yes
2 No
D Don't know
R Refused

31) What is your occupation?

RECORD TEXT RESPONSE _____

32) What is the highest grade or year of schooling that you have completed?

1 Less than high school
2 12^{th} grade / high school diploma / GED
3 Some college / 2-year college degree
4 4 or more years of college
D Don't know
R Refused

33) How long have you lived at this address? {DON'T READ CATEGORIES, RECORD ANSWER]

1 Less than one year
2 1-5 years
3 6-10 years
4 11 or more years
D Don't know
R Refused

34) Do any members of this household work for the [NAME OF INSTALLATION]?

1 Yes
2 No
D Don't know
R Refused

35) Have any members of your family household ever served in the Armed Services?

1 Yes
1 No → Go to question 36
D Don't know → Go to question 36
R Refused → Go to question 36

35a) Is that a son, daughter, spouse, parent, or some other relation?
CHECK AL THAT APPLY

1 Son
2 Daughter
3 Spouse
4 Parent
D Don't know
R Refused

36) Do any members of this household receive retirement or disability income as result of military or civilian service in the Department of Defense?

1 Yes
2 No
D Don't know
R Refused

37) Do you rent or own your home?

1 Rent

2 Own
3 Other→SPECIFY
D Don't know
R Refused

38) About how old is your home or the building your residence is in? Would you say it is 10 years old or less, 11-20 years old, 21-30 years old, 31-40 years old, or more than 40 years old?

1 0-10 years
2 11-20 years
3 21-30 years
4 31-40 years
5 41 years and over
D Don't know
R Refused

39) How old are most of the windows in your residence? Would you say most are 10 years old or less, 11-20 years old, 21-30 years old, 31-40 years old, or more than 40 years old?

1 0-10 years
2 11-20 years
3 21-30 years
4 31-40 years
5 41 years and over
D Don't know
R Refused

40) What is the type of house construction? Would you say the primary construction is brick, stone, wood, aluminum, a modular unit, concrete block, or something else?

1 Brick
2 Stone
3 Wood frame
4 Aluminum siding
5 Modular unit
6 Concrete block
D Don't know
R Refused

41) How would you describe the style of your house? Would you say it is a two-story, a ranch, a bi-level, or some other style?

1 Two story
2 Two story with basement
3 Ranch on concrete slab
4 Ranch with basement

5 Bi-level
6 Other style →SPECIFY _____
D Don't know
R Refused

42) To the best of your knowledge is your hearing normal?

1 Yes
2 No
D Don't know
R Refused

42a) [IF NO]: What hearing loss do you have?

ENTER RESPONSE

[Thank respondent for their time and terminate interview]

43) [INTERVIEWER]: Did the Respondent's hearing capacity seem to be:

1 Normal
2 Somewhat Diminished -→ DESCRIBE EXTENT OF PROBLEM
3 Severely Diminished -→ DESCRIBE EXTENT OF PROBLEM

If Somewhat or Severely Diminished, describe extent of problem

_____

_____

Appendix C: Complaint Survey Recruitment and Consent

Complaint Phone Survey
Recruitment/Consent

An Investigation of Community Attitudes towards Noise

The Complaint Survey includes this content at the beginning of the phone conversation

October 17 2008
Modified February 10 2009

INTERVIEW ID: _____
Telephone number)

INTERVIEW DATE: ____ /____/_____
(mo)/(day)/(year)

INTERVIEW TIME: ____:____ AM or PM (survey is to be conducted between 9 AM and 8 PM)

INTERVIEWER ID: ____

RESPONDENT SELECTION:

- Ask for individual who registered the complaint by name. To avoid a hard refusal of participation on the part of the complainant, the interviewer may state: *"We understand you recently contacted by name of Army installation. We're calling you to follow-up on that."* See script provided below.
- For other households, ask to speak with an adult who is typically at home during the day on weekdays (or at time of day/day of week of complaint)

OMB No.: 0710-0015
OMB Expires: 31 May 2011

Agency Disclosure Notice

The public report burden for this information collection is estimated to average 30 - 45 minutes for the interview, including the time for reviewing instructions, searching existing data sources, gathering and maintaining data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this data collection, including suggestions for reducing this burden, to Department of Defense, Washington Headquarters Services, Executive Services Directorate, Information Management Division, (0710-0015), 1155 Defense Pentagon, Washington DC, 20301-1155, and the Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, D.C. 20503, Attn.: Desk Officer for U.S. Army Corps of Engineers.

Respondents should be aware that not withstanding any other provision of law, an agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. PLEASE DO NOT RETURN YOUR SURVEY TO THE ABOVE ADDRESSES.

Good morning/afternoon/evening! My name is _____ and I am calling on behalf of Pennsylvania State University and the Army Corps of Engineers. We are conducting a research study about residents' attitudes about their community. It is important that we talk to different types of people and your household is one of a small number randomly selected from this community.

(When contacting the complainant ask for that individual. To avoid a hard refusal of participation on the part of the complainant, the interviewer may state): We understand you recently contacted by "name of Army installation". We're calling you to follow-up on that.

For the purpose of this study, I need to speak with a member of your household age 18 or older who is usually home on [WEEKDAYS/WEEKENDS] during [FILL PORTION OF DAY]. Is there an adult in your household who is usually home at that time?

1	Yes	
2	No	→ Go to Thank You and exit
D	Don't know	→ Go to Thank You and exit
R	Refused	→ Go to Thank You and exit

[If different person comes to phone, repeat intro shown above]

Confirm R's location is in the study area:
I would like to verify your location. Do you live at [STREET ADDRESS]?

1 Yes
2 No --> Go to Thank You and exit

Consent

Before we begin, I need to tell you a few things. This will take about *10 minutes* and all information you give me will be confidential. It will be used for statistical analysis, *and information that would identify you will NOT be released.* Your participation is *voluntary*. *If we come to a question you do not wish to answer, let me know and we will go to the next question.* You can quit at any time.

Responding to the survey questions implies your consent to participate in the survey. If you have any questions about the survey, you can contact Kathleen K. Hodgdon at (814) 865-2447 at the Pennsylvania State University or Peg Krecker at (608) 443-2700 at PA Consulting Group.

Do you have any questions before we begin?
1 Yes
2 No

Appendix D: Definitions and Rules for Survey Execution

Definitions

Area
The A-level grid cell of the complainant and the eight adjacent grid cells. (An A-level grid cell is 1 km^2.)

Complaint Sample Point
The complaint that is used to draw a set of nine matched households.

Matched Household
A randomly sampled household that is located in the same "Area" as the Complaint Sample Point.

Event
A cluster of complaints that occur within a 3-hour window.

Rules for survey execution

- No subject (complainant or matched household) will be surveyed more than two times throughout the study.
- Repeat complainants will be included in the sample a maximum of two times. That is, once as their first complaint and once for their second complaint.
- Complainants are not eligible to be a matched-sample point for a subsequent complaint by a different household.
- A household cannot be contacted or interviewed as a "matched-sample point" more than once. However, a household that has been contacted or interviewed as a matched sample is eligible to be included as a complaint sample point if a member of the household subsequently files a qualifying a noise complaint.
- If a subject files more than one complaint during a 24-hour period, only the first complaint will be eligible for sampling. This subject will be flagged as filing multiple complaints in one 24-hour period.
- One complaint will be sampled per event per area.
- If more than one complaint is made for a single event and all complaints are from the same "area," one of these complaints to be the "complainant sample point" will be randomly selected.

- If more than one complaint is made for a single event and the complaints are from "different areas," one complaint sample point per area for up to three randomly selected areas will be selected.
- If more than one complaint is made for a single event, the number of total complaints made for that event will be noted.
- On days with complaints due to multiple events, the number of events will be limited to three.
- If the events are distributed throughout the day, complaints that occur in a 3-hr time period will be grouped into one event.
- The event grouping will be organized by the time of the event noted in the text of complaint filing.
- If the timeframe noted in the text is indefinite (e.g., "this morning"), the time the complaint was filed will be used.
- Cases where the time of complaint contradicts the indefinite time period listed in the complaint text (e.g., filed at 3 p.m. and list "this morning" as the time of event) will be dealt with on a case-by-case basis.
- If the complaints are all in one time period and the events are all from the same area, then the complaint sample point will be randomly selected.
- If more than one complaint is made for a single event that is chosen on a day with multiple events, the sampling protocol as defined above will be followed.
- On days with complaints due to multiple events, the number of total complaints made for each event during that day will be noted.
- Matched-sample points for each complainant sample point will be identified to complete the nine matched-sample interviews. Samples will be released in an initial batch of 60 records to support data collection, with additional sample released as necessary. The objective is to complete the interviews within 1 week of the complaint, with a maximum timeframe of 2 weeks.
- The grid maps of the communities around the installation will be used to establish criteria as to "same" vs. "different" areas for sampling purposes. Complaints occurring within the same grid cells count as occurring in the same area and one randomly chosen complaint will be included. In the case of multiple complaints from a single event, in which the complaints are widespread across multiple grid cells, complaints occurring in adjacent cells may be viewed as one area. The A-level grid cells (1 km^2) will be used to establish areas. The resolution of the grid cells was selected based on the assumption that there should be less noise level variability than would occur in larger geographic area. At this level of resolution, it is possible for two complaints from adjacent

A-level grid cells to live across the street from each other, but both would be eligible for inclusion. Randomly sampling matched households from within the respective A-level cells would minimize the chances of extremely close proximity of all respondents for that noise event and the data records that would correspond to "complainant + matched households."

- Matched households should be identified and selected from the same A-level grid cell in which the complainant is located plus the eight adjacent A-level cells. If the nine-cell area does not contain a sufficient number of households (e.g., sparse population, bounded by water, previously sampled), the area may be expanded to include the surrounding 16 grid cells.

Appendix E: ANOVA and ANCOVA

The formal analysis included both an ANOVA and an analysis of covariance (ANCOVA). There are three key assumptions underlying the use of ANOVA:

1. That the observations (here, these are annoyance ratings) are independently drawn
2. That the observations are drawn from normally distributed populations
3. That those populations all have the same amount of variability in the annoyance of their members.

When a continuous predictor variable (called a covariate) is included in an ANOVA, the analysis is referred to as an analysis of covariance, or ANCOVA. ANCOVA combines regression analyses with ANOVA models. Therefore, ANCOVA models are subject to the same three key assumptions listed above for ANOVA models, and also assume that the relationship between the covariate and response is linear and that the slope of this linear relationship remains constant in each of the different groups examined in the ANOVA analysis. Typically, a covariate is included when it explains a significant proportion of the variability in the response variable. This study included multiple predictor variables, including individual noise sensitivity as a covariate predictor of annoyance.

Appendix F: Distribution of Responses (All Respondents)

Q1	How would you rate this neighborhood overall as a place to live?	Percent of Respondents
1	Terrible	1.5%
2	Poor	1.5%
3	Average	12.2%
4	Good	33.0%
5	Excellent	50.8%
-8	Don't know	1.0%
-9	Refused	0.0%
Q4	While we are interested in all neighborhood conditions, we are particularly interested in the various kinds of noises that people hear in this area. Do you think your neighborhood is quiet or noisy or about average?	
1	Quiet	68.0%
2	Average	19.8%
3	Noisy	12.2%
-8	Don't know	0.0%
-9	Refused	0.0%
	Now I am going to read a list of common neighborhood noises. Please rate the degree of annoyance, if any, which you experience from each noise source. For each noise source, please tell me if you find it not at all annoying, slightly annoying, moderately annoying, very annoying, or extremely annoying.	
Q6a Barking dogs		
1	Not at all annoying	62.9%
2	Slightly annoying	15.7%
3	Moderately annoying	10.2%
4	Very annoying	6.1%
5	Extremely annoying	5.1%
-8	Don't know	0.0%
-9	Refused	0.0%
Q6b Playing children		
1	Not at all annoying	94.9%
2	Slightly annoying	2.5%
3	Moderately annoying	1.5%
4	Very annoying	0.0%
5	Extremely annoying	0.0%
-8	Don't know	1.0%
-9	Refused	0.0%
Q6c	Thunder	
1	Not at all annoying	71.6%
2	Slightly annoying	15.7%
3	Moderately annoying	9.6%
4	Very annoying	0.5%
5	Extremely annoying	0.5%
-8	Don't know	1.5%
-9	Refused	0.5%
Q7	Do you enjoy fireworks at organized events?	
1	Yes	81.7%
2	No	17.8%
-8	Don't know	0.0%
-9	Refused	0.5%
Q8	Please rate the degree of annoyance, if any, which you experience from listening to fireworks at organized events. (Please tell me if you find it not at all annoying, slightly annoying, moderately annoying, very annoying, or extremely annoying.)	
1	Not at all annoying	70.6%
2	Slightly annoying	14.7%

3	Moderately annoying	8.6%
4	Very annoying	2.5%
5	Extremely annoying	2.0%
-8	Don't know	1.0%
-9	Refused	0.5%
Q9	Do you enjoy amateur fireworks set off by neighbors in your community?	
1	Yes	42.1%
2	No	54.8%
-8	Don't know	3.0%
-9	Refused	0.0%
Q10	Please rate the degree of annoyance, if any, which you experience from listening to amateur fireworks in your community.	
1	Not at all annoying	47.2%
2	Slightly annoying	13.2%
3	Moderately annoying	13.2%
4	Very annoying	10.7%
5	Extremely annoying	10.2%
-8	Don't know	4.6%
-9	Refused	1.0%
	Other residents in this area have mentioned the following types of noises. Please rate the degree of annoyance you experience in this neighborhood from each source. For each noise source, please tell me if you find it not at all annoying, slightly annoying, moderately annoying, very annoying, or extremely annoying.	
Q11a	Street traffic	
1	Not at all annoying	67.0%
2	Slightly annoying	17.8%
3	Moderately annoying	9.6%
4	Very annoying	2.5%
5	Extremely annoying	1.5%
-8	Don't know	1.5%
-9	Refused	0.0%
Q11b	Aircraft	
1	Not at all annoying	68.5%
2	Slightly annoying	19.8%
3	Moderately annoying	7.1%
4	Very annoying	2.0%
5	Extremely annoying	2.5%
-8	Don't know	0.0%
-9	Refused	0.0%
Q12a	Other residents in the area have mentioned military noise. Do you hear military noise?	
1	Yes	89.3%
2	No	10.7%
-8	Don't know	0.0%
-9	Refused	0.0%
Q12b	How would you rate the degree of annoyance, if any, you experience from military noise in this neighborhood? Do you find military noise to be not at all annoying, slightly annoying , moderately annoying, very annoying, or extremely annoying?	
1	Not at all annoying	27.4%
2	Slightly annoying	16.8%
3	Moderately annoying	19.3%

4	Very annoying	10.7%
5	Extremely annoying	15.2%
-1	Not applicable	10.7%
-8	Don't know	0.0%
-9	Refused	0.0%

PART 2: Awareness and Recall of Specific Noise Event that Triggered a Complaint

These next questions ask about whether you recall hearing any noise while you were at home on [day of the week/date]. First, we need to find out when you were around home on that day.

Q13 Were you home on [day of the week/date], during [portion of the day of noise event]?

1	Yes	54.8%
2	No	34.5%
-8	Don't know	10.7%
-9	Refused	0.0%

Q14 While you were around home on [day of week/date] do you recall hearing any loud noises from **[Installation]**?

1	Yes	31.5%
2	No	18.3%
-1	Not applicable	45.2%
-8	Don't know	5.1%
-9	Refused	0.0%

Q15 About what time of the day did you hear the noise from **[Installation]**?

0000-2400	Time of day	0.0%
-1	Not applicable	81.8%
-8	Don't know	18.2%
-9	Refused	0.0%

Q16 [If R can't recall specific time, ask if it was early morning, mid-morning, late morning, early afternoon, mid-afternoon, late afternoon, early evening, mid evening, late evening.]

1	early morning	1.5%
2	mid morning	1.5%
3	late morning	2.0%
4	early afternoon	3.6%
5	mid afternoon	2.0%
6	late afternoon	1.0%
7	early evening	0.0%
8	mid evening	0.0%
9	late evening	0.0%
-1	Not applicable	84.8%
-8	Don't know	3.6%
-9	Refused	0.0%

Q17 Were you inside the home or outside of your home when you heard the noise from **[Installation]** on **[day of week/date]?**

1	Inside home	28.9%
2	Outside home	1.0%
3	Don't recall	0.0%
4	Both inside & outside*	1.0%
-1	Not applicable	68.5%
-8	Don't know	0.5%
-9	Refused	0.0%

Q18 What were you doing at the time you heard the noise on that day?

1	Quiet activity such as relaxing or sleeping	8.1%
2	Eating a meal or reading	2.5%
3	Watching TV, listening to music or talking	4.1%
4	Using appliances, power tools or lawn equipment	1.5%
5	Other (Specify)	14.7%
-1	Not applicable	68.5%
-8	Don't know	0.5%
-9	Refused	0.0%

Q19 Was the noise from **[Installation]** you heard around home on [day of week/date] not at all annoying, slightly annoying, moderately annoying, very annoying, or extremely annoying?

1	Not at all annoying	6.6%
2	Slightly annoying	3.6%
3	Moderately annoying	2.0%
4	Very annoying	7.1%
5	Extremely annoying	11.7%
-1	Not applicable	68.5%
-8	Don't know	0.5%
-9	Refused	0.0%

Q20 Was the noise from **[Installation]** you heard around home on **[day of week/date]** not at all intrusive, slightly intrusive, moderately intrusive, very intrusive, or extremely intrusive?

		6.1%
1	Not at all intrusive	3.6%
2	Slightly intrusive	4.1%
3	Moderately intrusive	8.1%
4	Very intrusive	8.6%
5	Extremely intrusive	0.0%
-1	Not applicable	68.5%
-8	Don't know	1.0%
-9	Refused	0.0%

Q21 Did you experience any rattle or vibration in your home from a noise from **[Installation]** on **[day of week/date]?**

1	Yes	27.4%
2	No	4.1%
-1	Not applicable	68.5%
-8	Don't know	0.0%
-9	Refused-	0.0%

Q22_1 Windows

0	Not mentioned	6.1%
1	Mentioned	20.8%
-1	Not applicable	72.6%
-8	Don't know	0.5%
-9	Refused	0.0%

Q22_2 Walls

0	Not mentioned	15.7%
1	Mentioned	11.2%
-1	Not applicable	72.6%
-8	Don't know	0.5%
-9	Refused	0.0%

Q22_3 Shelves

0	Not mentioned	21.3%
1	Mentioned	5.6%
-1	Not applicable	72.6%
-8	Don't know	0.5%
-9	Refused	0.0%

Q22_4	China	
0	Not mentioned	20.8%
1	Mentioned	6.1%
-1	Not applicable	72.6%
-8	Don't know	0.5%
-9	Refused	0.0%
Q22_5	Small decorative items, such as "bric a brac" or "knick knacks'	
0	Not mentioned	19.8%
1	Mentioned	7.1%
-1	Not applicable	72.6%
-8	Don't know	0.5%
-9	Refused	0.0%
Q22_6	Other (SPECIFY)	
0	Not mentioned	20.8%
1	Mentioned	6.1%
-1	Not applicable	72.6%
-8	Don't know	0.5%
-9	Refused	0.0%
Q22_9	Pictures*	
0	Not mentioned	23.9%
1	Mentioned	3.0%
-1	Not applicable	72.6%
-8	Don't know	0.5%
-9	Refused	0.0%
Q22_10	Floors*	
0	Not mentioned	25.4%
1	Mentioned	1.5%
-1	Not applicable	72.6%
-8	Don't know	0.5%
-9	Refused	0.0%
Q22_11	Entire house*	
0	Not mentioned	20.8%
1	Mentioned	6.1%
-1	Not applicable	72.6%
-8	Don't know	0.5%
-9	Refused	0.0%
Q22_12	Doors*	
0	Not mentioned	25.4%
1	Mentioned	1.5%
-1	Not applicable	72.6%
-8	Don't know	0.5%
-9	Refused	0.0%
Q23	Did the rattle or vibrations interfere with your ability to talk with others or hear conversations on that day?	
1	Yes	7.1%
2	No	19.8%
-1	Not applicable	72.6%
-8	Don't know	0.5%
-9	Refused	0.0%
Q24a	Did the noise from **[Installation]** you heard on **[day of week/date]** startle you or make you jump?	
1	Yes	18.3%

2	No	12.7%
-1	Not applicable	68.5%
-8	Don't know	0.5%
-9	Refused	0.0%

Q24b Did the noise frighten you?

1	Yes	10.2%
2	No	21.3%
-1	Not applicable	68.5%
-8	Don't know	0.0%
-9	Refused	0.0%

Q24c Did the noise cause you to feel irritable or edgy?

1	Yes	11.2%
2	No	19.8%
-1	Not applicable	68.5%
-8	Don't know	0.5%
-9	Refused	0.0%

Q24d Did the noise make you become tense or nervous

1	Yes	10.7%
2	No	20.8%
-1	Not applicable	68.5%
-8	Don't know	0.0%
-9	Refused	0.0%

Part 3: General Attitudes and Characteristics of Residence

Q25A I'm going to read several statements. For each statement, please tell me if you strongly disagree, somewhat disagree, neither agree nor disagree, moderately agree or strongly agree.
I believe that people have a hard time getting used to noise

1	Strongly disagree	7.1%
2	Somewhat disagree	13.7%
3	Neither agree nor disagree	13.2%
4	Moderately agree	46.7%
5	Strongly agree	14.7%
-8	Don't know	2.5%
-9	Refused	2.0%

Q25B I believe that people get used to road traffic noise
(IF NECESSARY: Do you strongly disagree, somewhat disagree, neither agree nor disagree, moderately agree or strongly agree?)

1	Strongly disagree	4.6%
2	Somewhat disagree	7.1%
3	Neither agree nor disagree	5.6%
4	Moderately agree	53.3%
5	Strongly agree	24.9%
-8	Don't know	2.5%
-9	Refused	2.0%

Q25C I believe that with time most people adapt to noise
(IF NECESSARY: Do you strongly disagree, somewhat disagree, neither agree nor disagree, moderately agree or strongly agree?)

1	Strongly disagree	4.6%
2	Somewhat disagree	6.6%
3	Neither agree nor disagree	10.2%
4	Moderately agree	46.2%
5	Strongly agree	29.4%
-8	Don't know	1.5%
-9	Refused	1.5%

Q25D I believe that with time I can adapt to noise
(IF NECESSARY: Do you strongly disagree, somewhat disagree, neither agree nor disagree, moderately agree or strongly agree?)

1	Strongly disagree	13.2%
2	Somewhat disagree	4.6%
3	Neither agree nor disagree	11.2%
4	Moderately agree	39.1%
5	Strongly agree	31.0%
-8	Don't know	1.0%
-9	Refused	0.0%

Q25E I believe that with time I can get used to even the loudest noise
(IF NECESSARY: Do you strongly disagree, somewhat disagree, neither agree nor disagree, moderately agree or strongly agree?)

1	Strongly disagree	45.2%
2	Somewhat disagree	18.3%
3	Neither agree nor disagree	7.6%
4	Moderately agree	14.2%
5	Strongly agree	12.2%
-8	Don't know	2.5%
-9	Refused	0.0%

Q25F During the past 6 months, have you or anyone else in your household complained to **[Installation]** about military noise in your neighborhood?

1	Yes	9.1%
2	No	90.4%
-8	Don't know	0.5%
-9	Refused	0.0%

Q25G About how many times have you or another member of your household complained in the past 6 months? Would you say once, 2 or 3 times, 4 to 6 times, or more than 6 times?

1	Once	3.6%
2	2 or 3 times	2.5%
3	4 to 6 times	1.5%
4	More than 6 times	1.5%
-1	Not applicable	90.9%
-8	Don't know	0.0%
-9	Refused	0.0%

Q26 How would you rate the importance of **[Installation]** for the economic health of your town and county? Is it not at all important, slightly important, moderately important, very important, or extremely important?

1	Not at all important	26.4%
2	Slightly important	6.6%
3	Moderately important	14.2%
4	Very important	18.8%
5	Extremely important	22.3%
-8	Don't know	10.7%
-9	Refused	1.0%

Q27 How would you rate the importance of **[Installation]** for public health in your town and Is it not at all important, slightly important, moderately important, very important, or extremely important?

1	Not at all important	28.4%
2	Slightly important	6.1%
3	Moderately important	17.8%
4	Very important	13.2%
5	Extremely important	9.6%
-8	Don't know	23.4%

-9	Refused	1.5%

Q28 How would you rate the importance of Federal funding to your local school district from the **[Installation]**? Is it not at all important, slightly important, moderately important, very important, or extremely important?

1	Not at all important	20.3%
2	Slightly important	4.1%
3	Moderately important	13.7%
4	Very important	18.3%
5	Extremely important	12.2%
-8	Don't know	29.9%
-9	Refused	1.5%

Q29 One role that military installations are expected to fulfill is to serve as environmental caretakers of Federal lands, protecting rare and endangered species and, when appropriate, providing opportunities for recreation, such as hunting and fishing and outdoor activities. How would you rate the job **[Installation]** has done in caring for this environment? Have they been . . . .

1	Terrible	6.6%
2	Poor	7.6%
3	Average	16.8%
4	Good	16.8%
5	Excellent	7.6%
-8	Don't know	44.2%
-9	Refused	0.5%

Q30 OK, we are almost finished. I just have a few more questions about your residence. Including yourself, how many people live in your household?

1	Household size	17.8%
2		57.4%
3		10.7%
4		9.6%
5		3.6%
6		0.5%
7		0.5%
8		0.0%
-8	Don't know	0.0%
-9	Refused	0.0%

Q30a [IF >1 in household:]
Do any children under age 6 live in your household?

1	Yes	11.2%
2	No	71.1%
-1	Not applicable	17.8%
-8	Don't know	0.0%
-9	Refused	0.0%

Q32 What is the highest grade or year of schooling that you have completed?

1	Less than high school	4.1%
2	12th grade / high school diploma / GED	28.4%
3	Some college / 2-year college degree	29.9%
4	4 or more years of college	37.1%
-8	Don't know	0.0%
-9	Refused	0.5%

Q33 How long have you lived at this address?

1 Less than one year	2.0%
2 1-5 years	21.3%
3 6-10 years	23.4%
4 11 or more years	52.8%
-8 Don't know	0.5%

-9 Refused		0.0%

Q34 Do any members of this household work for the **[Installation]**?

1 Yes		5.6%
2 No		94.4%
-8 Don't know		0.0%
-9 Refused		0.0%

Q35 Have any members of your family household ever served in the Armed Services?

1	Yes	43.7%
2	No	56.3%
-8	Don't know	0.0%
-9	Refused	0.0%

Q35a_1	Son	
0	Not mentioned	41.1%
1	Mentioned	2.5%
-1	Not applicable	56.3%

Q35a_2	Daughter	
0	Not mentioned	43.7%
1	Mentioned	0.0%
-1	Not applicable	56.3%

Q35a_3	Spouse	
0	Not mentioned	21.8%
1	Mentioned	21.8%
-1	Not applicable	56.3%

Q35a_4	Parent	
0	Not mentioned	39.6%
1	Mentioned	4.1%
-1	Not applicable	56.3%

Q35a_5	Other	
0	Not mentioned	42.1%
1	Mentioned	1.5%
-1	Not applicable	56.3%

Q35a_6	Respondent*	
0	Not mentioned	26.9%
1	Mentioned	16.8%
-1	Not applicable	56.3%

Q36 Do any members of this household receive retirement or disability income as result of military or civilian service in the Department of Defense?

1	Yes	13.2%
2	No	86.3%
-8	Don't know	0.5%
-9	Refused	0.0%

Q37 Do you rent or own your home?

1	Rent	6.6%
2	Own	91.9%
3	Other SPECIFY	1.5%
-8	Don't know	0.0%
-9	Refused	0.0%

Q38 About how old is your home or the building your residence is in? Would you say it is 10 years old or less, 11-20 years old, 21-30 years old, 31-40 years old, or more than 40 years old?

1	0-10 years	19.8%
2	11-20 years	12.7%
3	21-30 years	14.2%
4	31-40 years	11.7%
5	41 years and over	40.6%
-8	Don't know	1.0%
-9	Refused	0.0%

Q39 How old are most of the windows in your residence? Would you say most are 10 years old or less, 11-20 years old, 21-30 years old, 31-40 years old, or more than 40 years old?

1	0-10 years	50.8%
2	11-20 years	18.8%
3	21-30 years	10.2%
4	31-40 years	5.1%
5	41 years and over	11.7%
-8	Don't know	3.6%
-9	Refused	0.0%

Q40 What is the type of house construction? Would you say the primary construction is brick, stone, wood, aluminum, a modular unit, concrete block, or something else?

1	Brick	22.3%
2	Stone	3.0%
3	Wood frame	49.2%
4	Aluminum siding	11.7%
5	Modular unit	3.0%
6	Concrete block	6.6%
7	Shaker shingles*	0.5%
8	Vinyl*	0.5%
9	Steel siding*	0.5%
10	Both brick & wood siding*	0.5%
11	Asbestos siding*	0.5%
-8	Don't know	1.5%
-9	Refused	0.0%

Q41 How would you describe the style of your house? Would you say it is a two-story, a ranch, a bi-level, or some other style?

1	Two story	13.2%
2	Two story with basement	21.3%
3	Ranch on concrete slab	11.2%
4	Ranch with basement	24.9%
5	Bi-level	3.6%
6	Other style (SPECIFY)	25.4%
-8	Don't know	0.0%
-9	Refused	0.5%

Q42 To the best of your knowledge is your hearing normal?

1	Yes	78.2%
2	No	21.8%
-8	Don't know	0.0%
-9	Refused	0.0%

Q43 Did the Respondent's hearing capacity seem to be:

1	Normal	90.4%
2	Somewhat Diminished - DESCRIBE EXTENT OF PROBLEM	9.6%
3	Severely Diminished - DESCRIBE EXTENT OF PROBLEM	0.0%

Appendix G: Group Descriptive Statistics

Matched-sample vs. complainants

Questions	Descriptor	Low Value	High Value	Matched Sample				Complainants			
				Median	Mean	STD	N	Median	Mean	STD	N
q1	Rate Neighborhood	1 - Terrible	5 - Excellent	5	4.3	0.8	175	5	4.2	1.3	20
q4	Quiet or Noisy?	1 - Quiet	3 - Noisy	1	1.4	0.7	176	1	1.6	0.9	21
q6a	Annoyance: Dogs	1 - Not at all annoying	5 - Extremely annoying	1	1.6	1.0	176	2	2.7	1.8	21
q6b	Annoyance: Children	1 - Not at all annoying	5 - Extremely annoying	1	1.1	0.3	174	1	1.0	0.2	21
q6c	Annoyance: Thunder	1 - Not at all annoying	5 - Extremely annoying	1	1.4	0.7	173	1	1.5	0.7	20
q7	Enjoy fireworks?	1 - Yes	2 - No	1	1.2	0.4	175	1	1.1	0.3	21
q8	Annoyance: Fireworks	1 - Not at all annoying	5 - Extremely annoying	1	1.5	0.9	173	1	1.3	0.6	21
q9	Enjoy amateur fireworks	1 - Yes	2 - No	2	1.6	0.5	170	2	1.6	0.5	21
q10	Annoyance: Amateur fireworks	1 - Not at all annoying	5 - Extremely annoying	2	2.2	1.4	165	1	2.1	1.6	21
q11a	Annoyance: Traffic	1 - Not at all annoying	5 - Extremely annoying	1	1.5	0.9	173	1	1.6	0.9	21
q11b	Annoyance: Aircraft	1 - Not at all annoying	5 - Extremely annoying	1	1.5	0.9	176	1	1.8	1.0	21
q12a	Hear military noise?	1 - Yes	2 - No	1	1.1	0.3	176	1	1.0	0.0	21
q12b	Annoyance: Military noise	1 - Not at all annoying	5 - Extremely annoying	2	2.5	1.4	155	4	4.1	1.1	21
q13	At home during event?	1 - Yes	2 - No	1	1.4	0.5	155	1	1.0	0.0	21
q14	Hear loud noises at home?	1 - Yes	2 - No	1	1.5	0.5	77	1	1.0	0.0	21
q15	When did you hear noise?	0	2400	1200	1460.0	433.0	16	1065	1087.9	290.2	16
q16	Approx. time of noise	1 - Early morning	9 - Late evening	4	3.7	1.6	19	2.5	2.8	1.0	4
q17	Inside or outside during noise?	1 - Inside	4 - Both inside & outside	1	1.2	0.7	40	1	1.0	0.0	21
q18	What were you doing during noise?	1 - Quiet activity	5 - Other (Specify)	5	3.6	1.7	40	3	3.0	1.8	21
q19	Was noise annoying?	1 - Not at all annoying	5 - Extremely annoying	3	3.0	1.6	41	5	4.4	1.2	20
q20	Was noise intrusive?	1 - Not at all intrusive	5 - Extremely intrusive	3	3.0	1.5	40	4.5	4.0	1.3	20
q21	Rattle or vibration?	1 - Yes	2 - No	1	1.2	0.4	41	1	1.0	0.2	21
q22_1	What rattled? Windows	0 - Not mentioned	1 - Mentioned	1	0.8	0.4	33	1	0.7	0.5	20
q22_2	What rattled? Walls	0 - Not mentioned	1 - Mentioned	0	0.3	0.5	33	1	0.6	0.5	20
q22_3	What rattled? Shelves	0 - Not mentioned	1 - Mentioned	0	0.2	0.4	33	0	0.2	0.4	20
q22_4	What rattled? China	0 - Not mentioned	1 - Mentioned	0	0.2	0.4	33	0	0.4	0.5	20
q22_5	What rattled? Small decorative items	0 - Not mentioned	1 - Mentioned	0	0.3	0.5	33	0	0.3	0.4	20
q22_6	What rattled? Other (specify)	0 - Not mentioned	1 - Mentioned	0	0.2	0.4	33	0	0.3	0.4	20
q22_9	What rattled? Pictures	0 - Not mentioned	1 - Mentioned	0	0.1	0.3	33	0	0.2	0.4	20
q22_10	What rattled? Floors	0 - Not mentioned	1 - Mentioned	0	0.1	0.3	33	0	0.0	0.0	20
q22_11	What rattled? Enitre house	0 - Not mentioned	1 - Mentioned	0	0.1	0.3	33	0	0.4	0.5	20
q22_12	What rattled? Doors	0 - Not mentioned	1 - Mentioned	0	0.1	0.2	33	0	0.1	0.2	20
q23	Interfere with conversations?	1 - Yes	2 - No	2	1.8	0.4	34	2	1.6	0.5	19
q24a	Did noise startle you?	1 - Yes	2 - No	1	1.5	0.5	41	1	1.3	0.4	20
q24b	Did noise frighten you?	1 - Yes	1 - No	2	1.7	0.4	41	2	1.6	0.5	21
q24c	Did noise irritate you?	1 - Yes	1 - No	2	1.8	0.4	41	1	1.4	0.5	20
q24d	Did noise make you nervous?	1 - Yes	1 - No	2	1.8	0.4	41	1	1.4	0.5	21
q25a	People have difficulty getting used to noise	1 - Strongly disagree	5 - Strongly agree	4	3.5	1.1	168	4	3.7	1.3	20
q25b	People get used to traffic noise	1 - Strongly disagree	5 - Strongly agree	4	3.9	1.0	167	4	3.9	1.3	21
q25c	People adapt to noise with time	1 - Strongly disagree	5 - Strongly agree	4	4.0	1.0	170	4	3.5	1.3	21
q25d	I adapt to noise with time	1 - Strongly disagree	5 - Strongly agree	4	3.8	1.3	174	3	3.0	1.6	21
q25e	I can get used to loudest noise	1 - Strongly disagree	5 - Strongly agree	2	2.4	1.5	171	1	1.5	1.0	21
q25f	Complained about military noise?	1 - Yes	2 - No	2	2.0	0.1	175	1	1.2	0.4	21
q25g	How many times?	1 - Once	4 - More than 6 times	1.5	1.5	0.7	2	2	2.2	1.2	16
q26	Instilation important for economic health?	1 - Not at all important	5 - Extremely important	3	3.1	1.6	158	2	2.6	1.7	16
q27	Instilation important for public health?	1 - Not at all important	5 - Extremely important	3	2.6	1.5	133	1	2.3	1.5	15
q28	Federal funding for schools	1 - Not at all important	5 - Extremely important	3	3.0	1.5	122	1	2.2	1.5	13
q29	How well does instilation care for environment?	1 - Terrible	5 - Excellent	3	3.3	1.1	98	2	2.5	1.4	11
q30	People in household	1-20 household size		2	2.3	1.1	176	2	2.0	0.7	21
q30a	Children under 6?	1 - Yes	2 - No	2	1.9	0.3	145	2	1.8	0.4	17
q32	Highest grade of schooling	1 - Less than high school	4 - 4 or more years of college	3	3.0	0.9	175	3	3.2	0.7	21
q33	How long at this address?	1 - Less than one year	4 - 11 or more years	4	3.3	0.9	175	3	3.2	0.8	21
q34	Do family members work for instilation?	1 - Yes	2 - No	2	1.9	0.2	176	2	2.0	0.0	21
q35	Family member served for armed forces?	1 - Yes	2 - No	2	1.5	0.5	176	2	1.8	0.4	21
q35a_1	Is that: son	0 - Not mentioned	1 - Mentioned	0	0.1	0.2	82	0	0.0	0.0	4
q35a_2	Is that: daughter	0 - Not mentioned	1 - Mentioned	0	0.0	0.0	82	0	0.0	0.0	4
q35a_3	Is that: spouse	0 - Not mentioned	1 - Mentioned	1	0.5	0.5	82	0	0.3	0.5	4
q35a_4	Is that: parent	0 - Not mentioned	1 - Mentioned	0	0.1	0.3	82	0.5	0.5	0.6	4
q35a_5	Is that: other	0 - Not mentioned	1 - Mentioned	0	0.0	0.2	82	0	0.0	0.0	4
q35a_6	Is that: respondant	0 - Not mentioned	1 - Mentioned	0	0.4	0.5	82	0.5	0.5	0.6	4
q36	Family members receive retirement/disability from DoD	1 - Yes	2 - No	2	1.9	0.4	175	2	2.0	0.2	21
q37	Rent or own home?	1 - Rent	2 - Own	2	1.9	0.3	176	2	2.0	0.3	21
q38	How old is home?	1 - 0-10 years	5 - 41 years and over	4	3.5	1.6	174	3	2.8	1.5	21
q39	How old are windows?	1 - 0-10 years	5 - 41 years and over	1	2.1	1.4	170	1	1.9	1.3	20
q40	What type of house?	1 - Brick	11 - Asbestos siding	3	3.1	1.7	173	3	3.0	1.3	21
q41	House style	1 - Two story	6 - Other style (SPECIFY)	4	3.6	1.8	175	4	3.3	1.8	21
q42	Is your hearing normal?	1 - Yes	2 - No	1	1.2	0.4	176	1	1.2	0.4	21
q43	Did respondent's hearing capacity seem:	1 - Normal	3 - Severely diminished	1	1.1	0.3	176	1	1.0	0.0	21

Non-complainants, first complainants, repeat complainants

Descriptor	Low Value	High Value	NC				FC				RC			
			Median	Mean	STD	N	Median	Mean	STD	N	Median	Mean	STD	N
Rate Neighborhood	1 - Terrible	5 - Excellent	5	4.3	0.8	173	5	4.6	0.7	10	4	3.7	1.5	11
Quiet or Noisy?	1 - Quiet	3 - Noisy	1	1.4	0.7	174	1	1.6	0.8	10	1	1.7	1.0	12
Annoyance: Dogs	1 - Not at all annoying	5 - Extremely annoying	1	1.6	1.0	174	2	2.4	1.6	10	2.5	2.8	1.9	12
Annoyance: Children	1 - Not at all annoying	5 - Extremely annoying	1	1.1	0.3	172	1	1.1	0.3	10	1	1.0	0.0	12
Annoyance: Thunder	1 - Not at all annoying	5 - Extremely annoying	1	1.4	0.7	171	1	1.3	0.7	10	2	1.7	0.8	11
Enjoy fireworks?	1 - Yes	2 - No	1	1.2	0.4	173	1	1.1	0.3	10	1	1.1	0.3	12
Annoyance: Fireworks	1 - Not at all annoying	5 - Extremely annoying	1	1.5	0.9	171	1	1.3	0.5	10	1	1.3	0.6	12
Enjoy amateur fireworks	1 - Yes	2 - No	2	1.6	0.5	168	2	1.6	0.5	10	2	1.6	0.5	12
Annoyance: Amateur fireworks	1 - Not at all annoying	5 - Extremely annoying	2	2.2	1.4	163	1	1.8	1.5	10	1.5	2.3	1.6	12
Annoyance: Traffic	1 - Not at all annoying	5 - Extremely annoying	1	1.5	0.9	171	1	1.5	0.7	10	1	1.6	1.0	12
Annoyance: Aircraft	1 - Not at all annoying	5 - Extremely annoying	1	1.5	0.9	174	1.5	1.8	1.0	10	1	1.8	1.1	12
Hear military noise?	1 - Yes	2 - No	1	1.1	0.3	174	1	1.0	0.0	10	1	1.0	0.0	12
Annoyance: Military noise	1 - Not at all annoying	5 - Extremely annoying	2	2.5	1.4	153	4	3.7	1.3	10	5	4.5	0.8	12
At home during event?	1 - Yes	2 - No	1	1.4	0.5	154	1	1.0	0.0	10	1	1.1	0.3	12
Hear loud noises at home?	1 - Yes	2 - No	1	1.5	0.5	77	1	1.0	0.0	10	1	1.0	0.0	11
When did you hear noise?	0	2400	1200	1460.0	433.0	16	1030	993.7	164.2	7	1400	1161.1	352.0	9
Approx. time of noise	1 - Early morning	9 - Late evening	4	3.7	1.6	19	2	2.0	0.0	2	3.5	3.5	0.7	2
Inside or outside during noise?	1 - Inside	4 - Both inside & outside	1	1.2	0.7	40	1	1.0	0.0	10	1	1.0	0.0	11
What were you doing during noise?	1 - Quiet activity	5 - Other (Specify)	5	3.6	1.7	40	3	2.8	1.8	10	3	3.1	1.9	11
Was noise annoying?	1 - Not at all annoying	5 - Extremely annoying	3	3.0	1.6	41	5	4.4	1.3	10	5	4.3	1.3	10
Was noise intrusive?	1 - Not at all intrusive	5 - Extremely intrusive	3	3.0	1.5	40	5	4.0	1.5	10	4	4.0	1.2	10
Rattle or vibration?	1 - Yes	2 - No	1	1.2	0.4	41	1	1.1	0.3	10	1	1.0	0.0	11
What rattled? Windows	0 - Not mentioned	1 - Mentioned	1	0.8	0.4	33	1	0.7	0.5	9	1	0.7	0.5	11
What rattled? Walls	0 - Not mentioned	1 - Mentioned	0	0.3	0.5	33	0	0.4	0.5	9	1	0.6	0.5	11
What rattled? Shelves	0 - Not mentioned	1 - Mentioned	0	0.2	0.4	33	0	0.2	0.4	9	0	0.2	0.4	11
What rattled? China	0 - Not mentioned	1 - Mentioned	0	0.2	0.4	33	0	0.3	0.5	9	0	0.4	0.5	11
What rattled? Small decorative items	0 - Not mentioned	1 - Mentioned	0	0.3	0.5	33	0	0.2	0.4	9	0	0.3	0.5	11
What rattled? Other (specify)	0 - Not mentioned	1 - Mentioned	0	0.2	0.4	33	0	0.1	0.3	9	0	0.4	0.5	11
What rattled? Pictures	0 - Not mentioned	1 - Mentioned	0	0.1	0.3	33	0	0.2	0.4	9	0	0.1	0.3	11
What rattled? Floors	0 - Not mentioned	1 - Mentioned	0	0.1	0.3	33	0	0.0	0.0	9	0	0.0	0.0	11
What rattled? Entire house	0 - Not mentioned	1 - Mentioned	0	0.1	0.3	33	0	0.3	0.5	9	0	0.5	0.5	11
What rattled? Doors	0 - Not mentioned	1 - Mentioned	0	0.1	0.2	33	0	0.0	0.0	9	0	0.1	0.3	11
Interfere with conversations?	1 - Yes	2 - No	2	1.8	0.4	34	1.5	1.5	0.5	8	2	1.7	0.5	11
Did noise startle you?	1 - Yes	2 - No	1	1.5	0.5	41	1	1.2	0.4	10	1	1.3	0.5	10
Did noise frighten you?	1 - Yes	2 - No	2	1.7	0.4	41	1	1.3	0.5	10	2	1.8	0.4	11
Did noise irritate you?	1 - Yes	2 - No	2	1.8	0.4	41	1	1.3	0.5	10	1	1.4	0.5	10
Did noise make you nervous?	1 - Yes	2 - No	2	1.8	0.4	41	1	1.3	0.5	10	2	1.5	0.5	11
People have difficulty getting used to noise	1 - Strongly disagree	5 - Strongly agree	4	3.5	1.1	166	3	2.9	1.4	10	4	4.3	0.9	11
People get used to traffic noise	1 - Strongly disagree	5 - Strongly agree	4	3.9	1.0	165	4	3.7	1.3	10	4	4.1	1.2	12
People adapt to noise with time	1 - Strongly disagree	5 - Strongly agree	4	4.0	1.0	168	4	3.5	1.4	10	4	3.5	1.2	12
I adapt to noise with time	1 - Strongly disagree	5 - Strongly agree	4	3.8	1.3	172	3.5	3.3	1.4	10	3	2.8	1.7	12
I can get used to loudest noise	1 - Strongly disagree	5 - Strongly agree	2	2.4	1.5	169	1	1.7	1.1	10	1	1.3	0.9	12
Complained about military noise?	1 - Yes	2 - No	2	2.0	0.0	173	1.5	1.5	0.5	10	1	1.0	0.0	12
How many times?	1 - Once	4 - More than 6 times	#NUM!	#DIV/0!	#DIV/0!	0	1	1.0	0.0	5	2.5	2.7	1.0	12
Instillation important for economic health?	1 - Not at all important	5 - Extremely important	3	3.1	1.6	156	3.5	3.0	1.8	8	1	2.2	1.5	9
Instillation important for public health?	1 - Not at all important	5 - Extremely important	3	2.6	1.5	131	3	2.6	1.5	8	1	2.1	1.6	8
Federal funding for schools	1 - Not at all important	5 - Extremely important	3	3.0	1.5	120	2	2.4	1.6	7	1	2.3	1.6	7
How well does instillation care for environment?	1 - Terrible	5 - Excellent	3	3.3	1.1	98	3	2.8	1.6	8	2	1.7	0.6	3
People in household	1-20 household size		2	2.3	1.1	174	2	2.2	0.9	10	2	1.8	0.4	12
Children under 6?	1 - Yes	2 - No	2	1.9	0.3	143	2	1.6	0.5	8	2	2.0	0.0	10
Highest grade of schooling	1 - Less than high school	4 - 4 or more years of college	3	3.0	0.9	173	3.5	3.2	0.9	10	3	3.2	0.6	12
How long at this address?	1 - Less than one year	4 - 11 or more years	4	3.3	0.9	173	3	2.9	0.9	10	4	3.5	0.7	12
Do family members work for instillation?	1 - Yes	2 - No	2	1.9	0.2	174	2	2.0	0.0	10	2	2.0	0.0	12
Family member served for armed forces?	1 - Yes	2 - No	2	1.5	0.5	174	2	1.7	0.5	10	2	1.8	0.4	12
Is that: son	0 - Not mentioned	1 - Mentioned	0	0.1	0.2	81	0	0.0	0.0	3	0	0.0	0.0	2
Is that: daughter	0 - Not mentioned	1 - Mentioned	0	0.0	0.0	81	0	0.0	0.0	3	0	0.0	0.0	2
Is that: spouse	0 - Not mentioned	1 - Mentioned	1	0.5	0.5	81	0	0.3	0.6	3	0	0.0	0.0	2
Is that: parent	0 - Not mentioned	1 - Mentioned	0	0.1	0.3	81	1	0.7	0.6	3	0	0.0	0.0	2
Is that: other	0 - Not mentioned	1 - Mentioned	0	0.0	0.2	81	0	0.0	0.0	3	0	0.0	0.0	2
Is that: respondant	0 - Not mentioned	1 - Mentioned	0	0.4	0.5	81	0	0.3	0.6	3	1	1.0	0.0	2
Family members receive retirement/disability from DoD	1 - Yes	2 - No	2	1.9	0.4	173	2	2.0	0.0	10	2	1.9	0.3	12
Rent or own home?	1 - Rent	2 - Own	2	1.9	0.3	174	2	2.0	0.5	10	2	2.0	0.0	12
How old is home?	1 - 0-10 years	5 - 41 years and over	4	3.5	1.6	172	1	2.2	1.7	10	3	3.3	1.1	12
How old are windows?	1 - 0-10 years	5 - 41 years and over	1	2.1	1.4	168	1	2.0	1.7	10	1	1.7	0.9	11
What type of house?	1 - Brick	11 - Asbestos siding	3	3.1	1.7	171	3	2.5	1.2	10	3	3.4	1.2	12
House style	1 - Two story	6 - Other style (SPECIFY)	4	3.6	1.8	173	2.5	3.2	1.8	10	4	3.4	1.8	12
Is your hearing normal?	1 - Yes	2 - No	1	1.2	0.4	174	1	1.3	0.5	10	1	1.3	0.5	12
Did respondent's hearing capacity seem:	1 - Normal	3 - Severely diminished	1	1.1	0.3	174	1	1.0	0.0	10	1	1.0	0.0	12

Appendix H: Description of Survey Variables and Covariates

Survey variables

The response data obtained were reviewed and prepared before analysis to group the potential predictor variables into a reasonable and manageable set. The final data were compiled such that responses to all closed-ended questions have valid numeric codes that match a designated response category, a response of "Don't know" or "Refused," or a logical skip because the question was inapplicable. The variables consider are provided in the following list and mirror the survey questions given in Appendix B. The covariates considered are briefly discussed below:

- Open Ended: Verbal responses evaluated in qualitative descriptive analysis
- General Response: Identified the respondent and noise event (time, date, etc.)
- Complainant used for Q12b (Annoyance to General Military Noise):
  - Matched-Sample
  - Complainant
- Complainant used for Q19 (Annoyance to Complaint-Referenced Blast Noise Event):
  - Non-complainant
  - First-time complainant
  - Repeat complainant
- Annoyance to General Military Noise
- Annoyance to Complaint-Referenced Blast Noise Event(s)
- Composite Noise Sensitivity Index or Annoyance Prediction:
  - Annoyance rating of impulsive sounds: thunder and barking dogs
  - Annoyance rating of continuous sounds: street traffic and aircraft flyovers
- Respondent perspective on ability to adapt to noise in environment:
  - Importance of the Installation
  - Contribution to economic health in area
  - Contribution to public health in area
  - Federal funding for local school district due to Installation
  - Role of installation as environmental caretaker of Federal land

- Characteristics of Respondent Household
  - Presence of children under the age of six
  - Respondent's level of education
  - Length of time at current address
  - Presence of installation employee in household
  - Retirement or disability income due to prior service with DoD
  - Respondent's self-rating of normal hearing acuity
  - Interviewer's impression of respondent's hearing acuity
  - Characteristics of the Respondent's house
  - Age of home
  - Age of windows
  - Distance from the Source.

Covariates

Composite Noise Sensitivity Index and Annoyance Prediction Variables

Responses from Question series 6, series 11 and series 25 were combined to create a noise sensitivity variable that was used as an indication of potential annoyance. This variable was named *Noise Sensitivity*. The responses to these questions indicate how likely it is that the respondent will be annoyed by an outside source of noise by assessing their sensitivity to those noise sources:

- Question 6 asked respondents to rate annoyance to various impulsive sounds heard within a community, including barking dogs and thunder.
- Questions 6 stated: "Now I am going to read a list of common neighborhood noises. Please rate the degree of annoyance, if any, which you experience from each noise source. For each noise source, please tell me if you find it not at all annoying, slightly annoying, moderately annoying, very annoying, or extremely annoying."
- Question 6a, "barking dogs," and 6c, "thunder," were incorporated into the noise sensitivity scale.
- Question 6b "playing children" was deleted due to lack of variability.
- Question 11 addressed annoyance due to noises from different modes of transportation.
- Question 11 stated: "Other residents in this area have mentioned the following types of noises. Please rate the degree of annoyance you experience in this neighborhood from each source. For each noise source, please tell me if you find it not at all annoying, slightly annoying, moderately annoying, very annoying, or extremely annoying."

- Question 11a, “Street traffic” and 11b, “Aircraft,” were incorporated into the noise sensitivity scale variable along with the responses to Question 25 series, which assessed adaptability.

Questions 25a-25e assessed the respondent’s self-perception of adaptability to noise and their perceptions in general of adaptability to noise. The series of questions read: “I’m going to read several statements. For each statement, please tell me if you strongly disagree, somewhat disagree, neither agree nor disagree, moderately agree, or strongly agree. The Questions were stated as follows:

- Question 25a, “ I believe that people have a hard time getting used to noise”
- Question 25b, “ I believe that people get used to road traffic noise”
- Question 25c, “ I believe that with time most people adapt to noise
- Question 25d, “ I believe that with time I can adapt to noise”
- Question 25e, “I believe that with time I can get used to even the loudest noise.”

The responses to these questions were incorporated into the noise sensitivity scale. Responses to the Question 6 and Question 11 series, and Question 25a were all are coded such that higher values indicate higher annoyance with noise. However, Questions 25b through 25e were all coded such that higher values indicate that noise is not a problem. Therefore, these values associated with responses to Questions 25b through 25e needed to be reverse-coded for inclusion in the model.

Importance of the Installation Variables

Questions 26 through 29 given in Appendix B and in Table 13 were combined to form a second possible covariate, this one measuring the importance of the installation in the community. The response values from these four questions were averaged after deleting all -8 and -9 values.

Table 13. Questions used in measuring the importance of the installation in the community.

No.	Question
Q26	How would you rate the importance of [Installation] for the economic health of your town and county?
Q27	How would you rate the importance of [Installation] for public health in your town and county?
Q28	How would you rate the importance of Federal funding to your local school district from the [Installation]?
Q29	How would you rate the job [Installation] has done in caring for this environment?

Distance from the source

The distance from the source was calculated from the geocoding of respondents' homes and the nearest source location (range).

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14. ABSTRACT

Current blast noise impact assessment procedures do not fully meet the military's noise management needs. In particular, it is unclear how an installation or range commander should interpret blast noise complaints. This work investigated whether there are significant differences in reported annoyance to complaint-referenced blast events (CRBEs) between complainants and their non-complaining neighbors. It was found that complainants were significantly more annoyed to both CRBEs and general military noise in comparison to their non-complaining neighbors. These findings are discussed in the context of range management.

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SERDP, complaint, annoyance, survey, human response, blast, blast noise, impulse, military training, military noise, noise management

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